Research Product 90-03

Trainer's Guide: Multipurpose Arcade Combat Simulator (MACS) Basic Rifle Marksmanship (M16 Rifle)

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November 1989

Fort Benning Field Unit
Training Research Laboratory

U.S. Army Research Institute for the Behavioral and Social Sciences

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Research accomplished under contract for
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Litton Computer Services

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Multipurpose Arcade Combat Simulator (MACS) is a low-cost, part-task weapons trainer that has been validated as a teaching device with entry-level soldiers. The system may be used for basic, preparatory, sustainment, and remedial training.

The MACS system has four parts: An M16 demilitarized or replica rifle with a light pen attached to the barrel; a Commodore 64 computer; a computer monitor; and a Basic Rifle Marksmanship (BRM) cartridge designed for use with the M16 rifle. MACS allows soldiers to practice marksmanship skills by firing at targets at scaled ranges displayed on a computer screen. Diagnostic feedback is provided on the screen.

The Trainer's Guide is intended to accompany each MACS system. The Guide provides instructions for assembly of the system and for correct alignment of the light pen mount.

Summary descriptions of each level of the program are provided along with descriptions of the feedback and standards at each level. In addition to the nine teaching levels, a sight and grouping program, designed to teach the basic skills of sight alignment and shot (Continued)

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18. SUBJECT TERMS (Continued)

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Rifles

19. ABSTRACT (Continued)

grouping to the novice marksman, is included. Other options include "call your shot" and incorporating the effects of wind of varying speeds and directions. The MACS system software is largely self-explanatory but assumes the presence of an instructor. Before using the MACS system as a teaching device with soldiers, the instructor should read the MACS Trainer's Guide and shoot the entire program several times to become familiar with the system.

Research Product 90-03

Trainer's Guide: Multipurpose Arcade Combat Simulator (MACS) Basic Rifle Marksmanship (M16 Rifle)

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FOREWORD

The Multipurpose Arcade Combat Simulator (MACS) is an inexpensive, part-task weapons trainer developed to overcome the training problems that result from insufficient facilities and too few instructors. Because it uses mostly off-the-shelf components, MACS is substantially lower in cost than other available training devices, although it is equally effective. While current interest is focused primarily on its use as a rifle marksmanship trainer, MACS was designed so that the basic hardware could be used to provide training on a variety of weapons systems.

The MACS Trainer's Guide provides instructions for assembling system hardware, aligning the light pen mount, and trouble shooting. Detailed descriptions of the Basic Rifle Marksmanship (BRM) software are provided, along with suggestions for using the software in training.

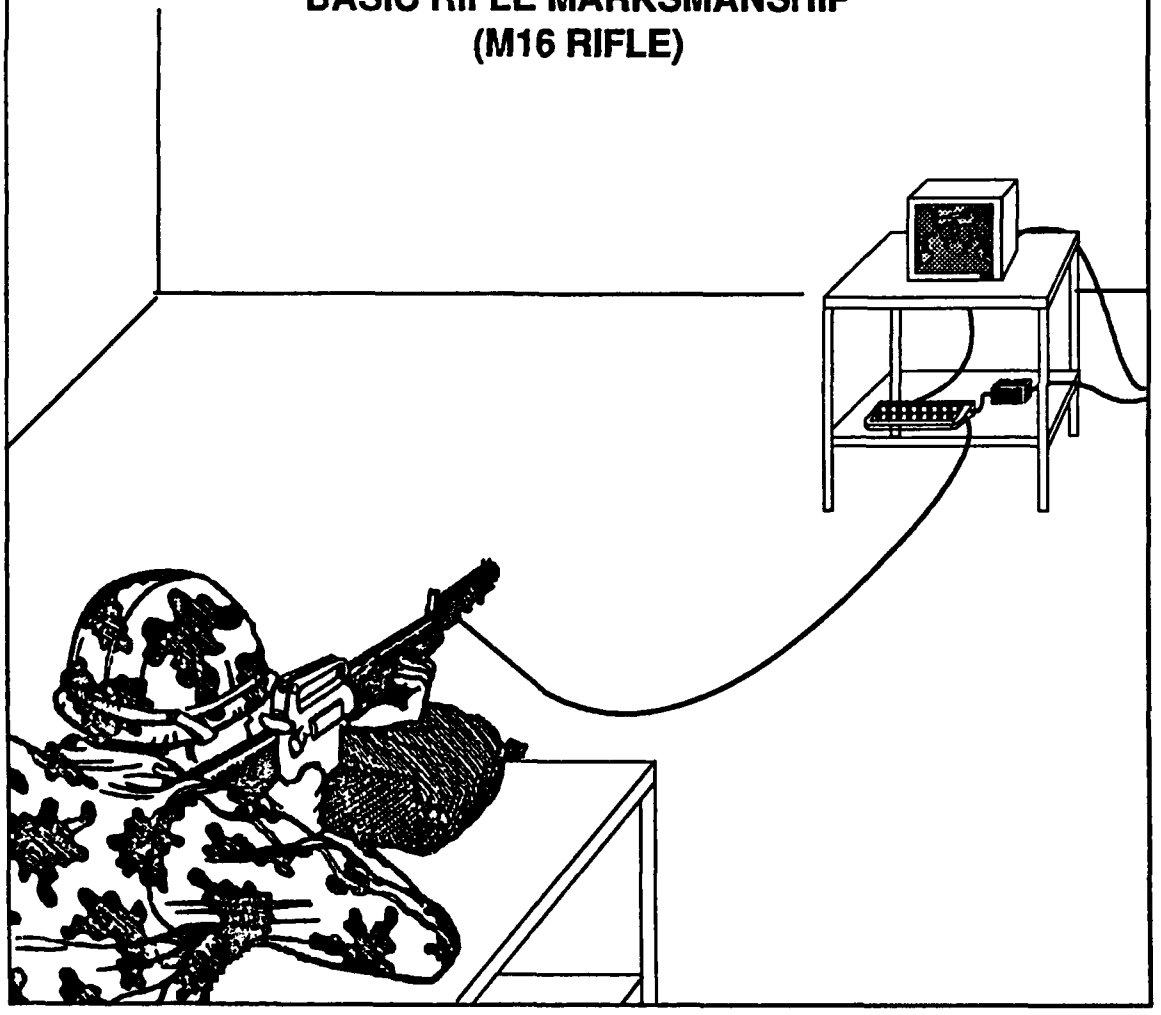
Patented in 1986, MACS is a product of the Army Research Institute Fort Benning Field Unit, which conducts research on training and training technology with particular emphasis on individual and small team skills in the Infantry arena. The research task that supports this mission is titled "Developing Training for Individual and Crew-served Weapons" and is organized under the "Training for Combat Effectiveness" program area. The U.S. Army Infantry School under a Memorandum of Understanding (9 December 1987) and the U.S. Army Training Support Center under a Training Device Need Statement for MACS approved in 1984 provided sponsorship for the MACS research program. The MACS system hardware and the BRM software described in this report are being distributed by the Training Support Center at Fort Benning, Georgia. The MACS Trainer's Guide accompanies each system.

EDGAR M. JOHNSON
Technical Director

TRAINER'S GUIDE

MULTIPURPOSE ARCADE COMBAT SIMULATOR

(MACS)
BASIC RIFLE MARKSMANSHIP
(M16 RIFLE)



Prepared by Jamie W. Purvis and Ellen W. Wiley of Litton Computer Services for the U. S. Army Research Institute Field Unit at Fort Benning, Georgia, under contract #MDA 903-88-C-0407.

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MACS SYSTEM ASSEMBLY INSTRUCTIONS

NOTE:

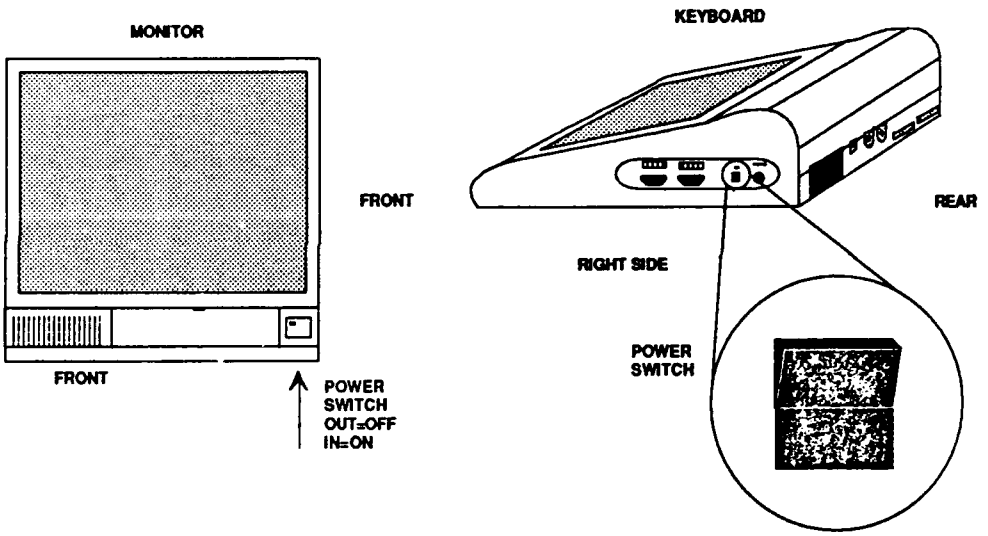
The MACS system can be easily assembled using the instructions found in this section. The instructions should be read before attempting to assemble the system to prevent damage to the system. Particular care must be taken to **NEVER** insert or remove the program cartridge while the keyboard power is **ON**.

MACS SYSTEM ASSEMBLY INSTRUCTIONS

PLEASE READ ALL INSTRUCTIONS BEFORE ATTEMPTING TO ASSEMBLE THE MACS SYSTEM.

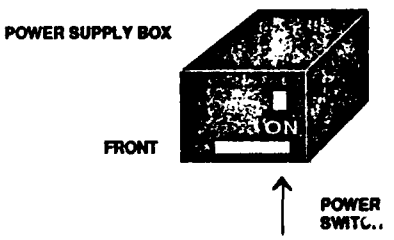
CAUTION:

- **MAKE SURE ALL EQUIPMENT IS TURNED OFF BEFORE PROCEEDING OR DAMAGE TO EQUIPMENT WILL RESULT.**



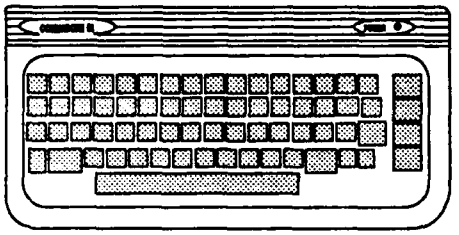
NOTE:

If your system contains a switched power supply box, please note that the power switch is on the front. If there is no power when the switch is in the ON position, check the fuse found in the back of the box.

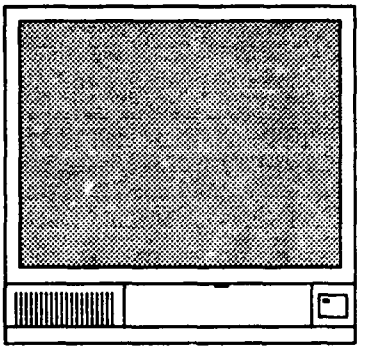


STEP 1: UNPACK EQUIPMENT

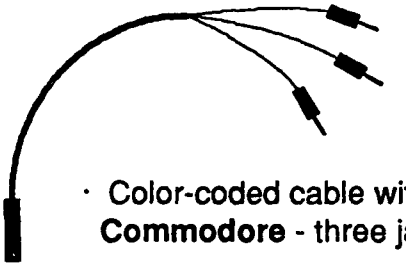
- Unpack the equipment carefully.
- Each system should have the following components:



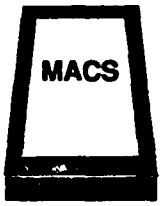
· Keyboard/computer



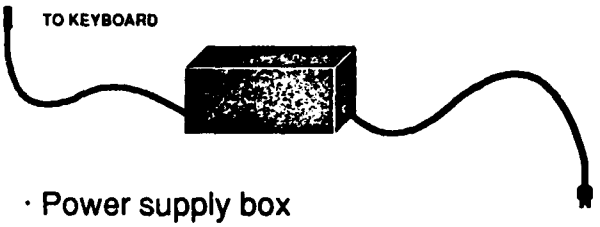
· 13" color monitor



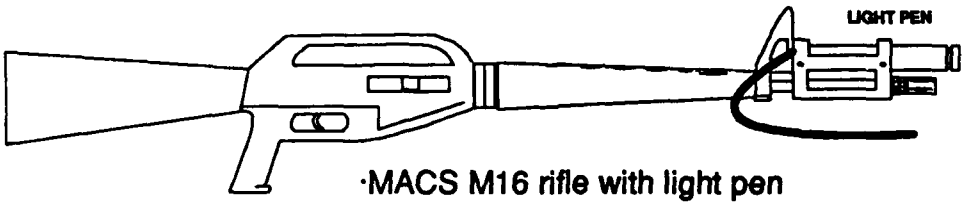
· Color-coded cable with jacks.
Commodore - three jacks used.



· MACS cartridge



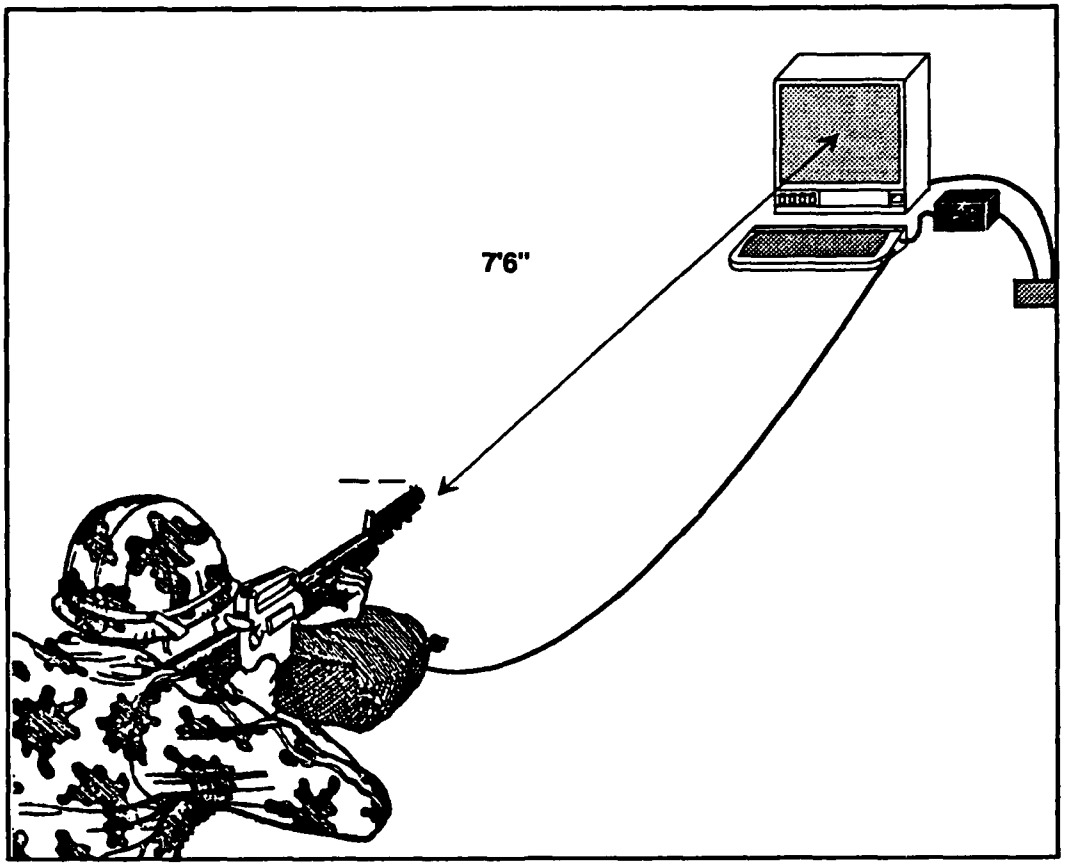
· Power supply box



·MACS M16 rifle with light pen

STEP 2: EQUIPMENT PLACEMENT

- All equipment should be placed on a firm, steady surface.
- Sandbags are required for supported position.
- Computer equipment should be located near a three-pronged receptacle.
- MACS M16 rifle should be aimed at monitor.
- Place monitor exactly **7'6"** from light pen.
- **NOTE:** Mark distance on connector cord.

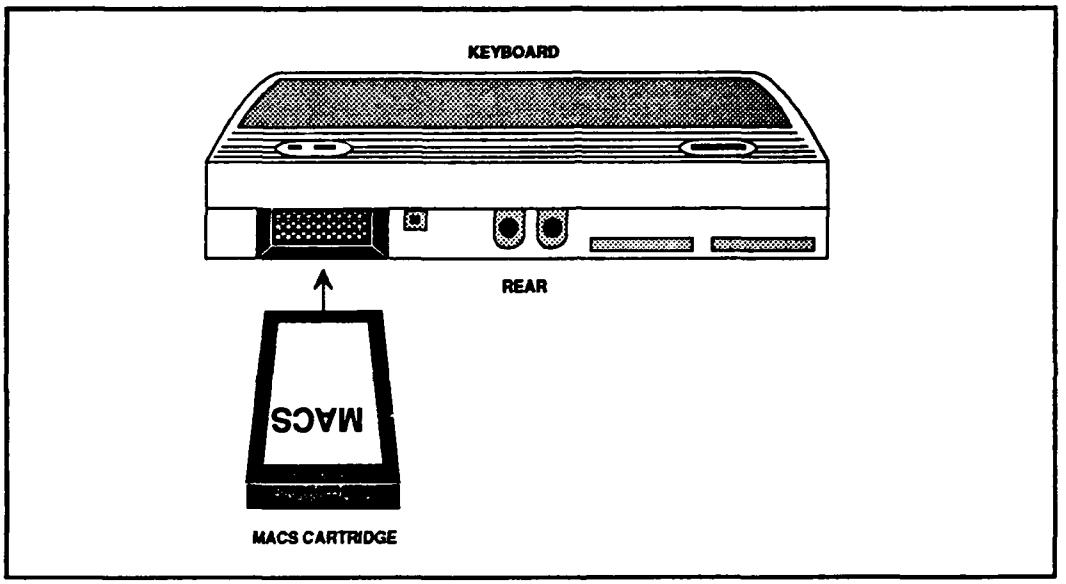


STEP 3 MACS CARTRIDGE

CAUTION:

- **MAKE SURE ALL EQUIPMENT IS TURNED OFF BEFORE PROCEEDING OR DAMAGE TO EQUIPMENT WILL RESULT.**

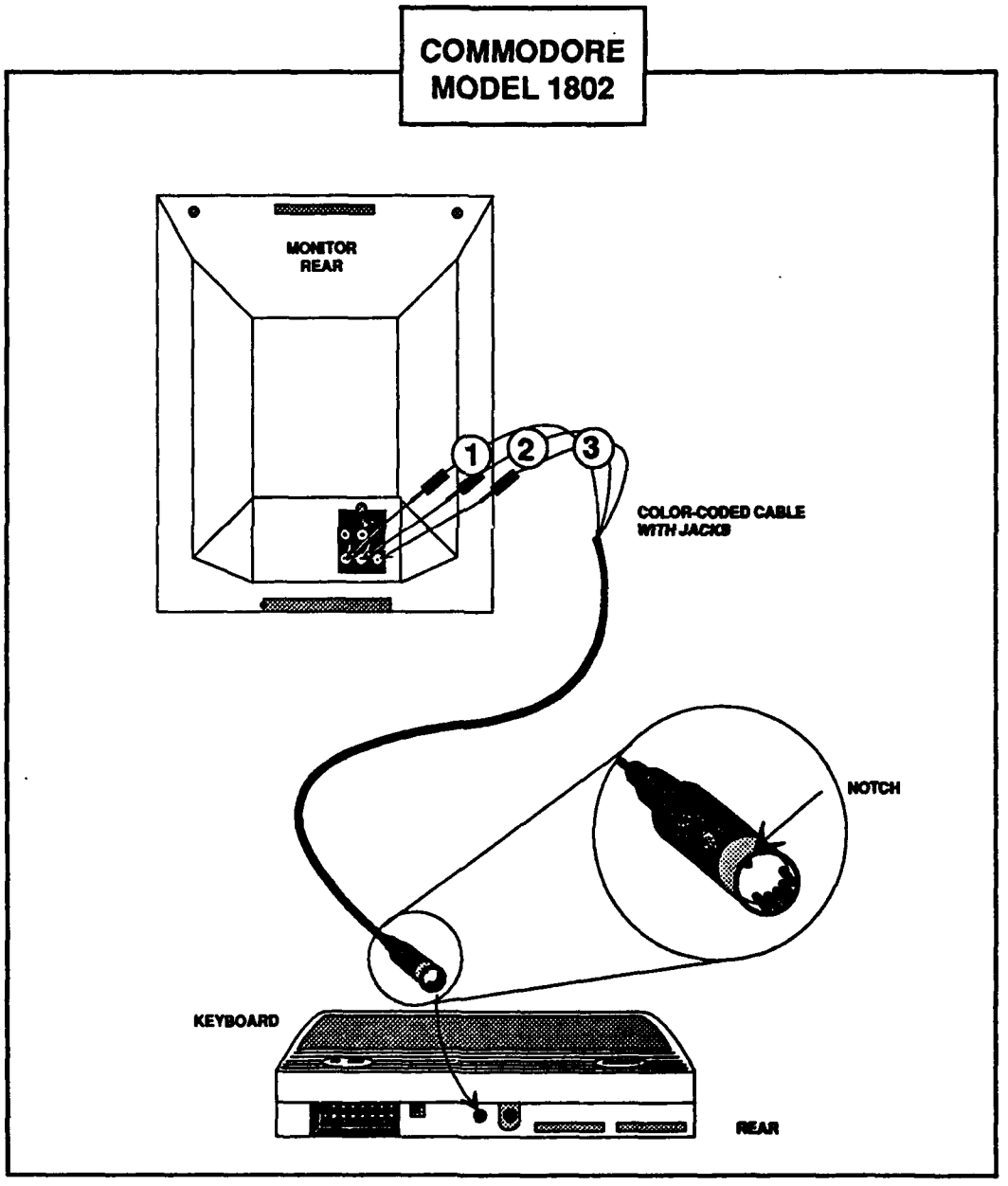
- Insert MACS cartridge (label up) into slot in back of keyboard.
  - **Use firm steady pressure, gently rocking cartridge left and right.**
  - Cartridge is firmly seated when it can no longer be rocked.



STEP 4 COLOR-CODED CABLE WITH JACKS

COMMODORE MONITOR (1802)

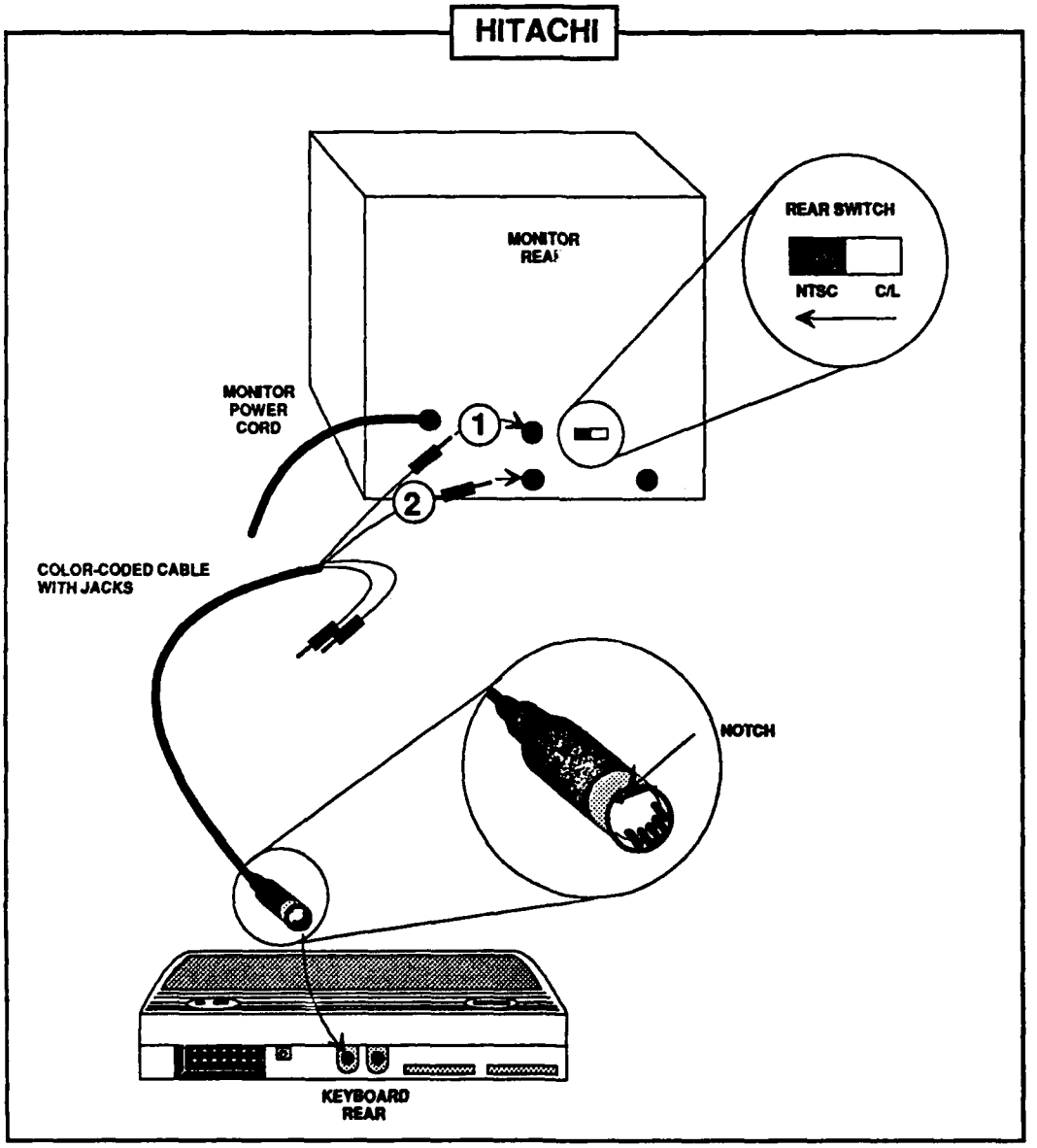
- Plug cable jacks into rear of monitor.
  - Sockets and cable jacks are color-coded
  - Jacks must be plugged in correct sockets for program to run correctly.
- With notch in twelve o'clock position, plug other end of color-coded cable into left-hand port as you face rear of keyboard.



STEP 4 COLOR-CODED CABLE WITH JACKS

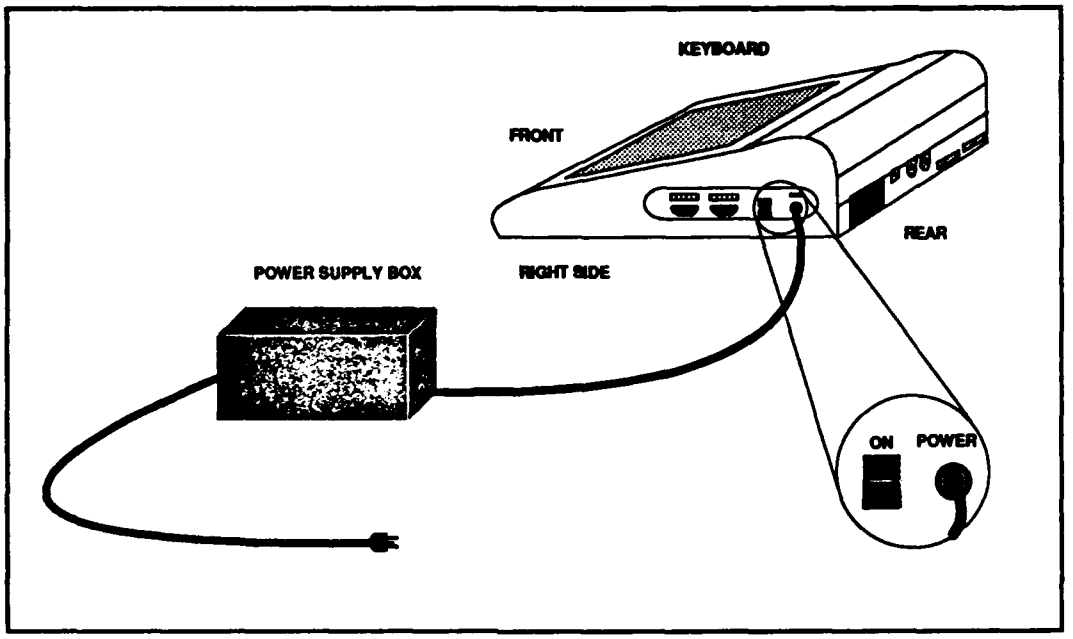
HITACHI MONITOR

- Plug cable jacks into rear of monitor.
  - Sockets and cable jacks are designated **1** and **2**.
  - IGNORE COLOR OF SOCKETS and JACKS!
  - IGNORE EXTRA JACKS!
  - Jacks must be plugged in correct sockets for program to run correctly.
- Set rear switch to **NTSC**.
- With notch in twelve o'clock position, plug other end of color-coded cable into left-hand port, as you face the rear of keyboard.



STEP 5 TERMINAL CONNECTION

- Plug terminal connection (from power supply box) into keyboard power socket.
  - As you face the keyboard, socket is found on right hand side next to the off-on switch.

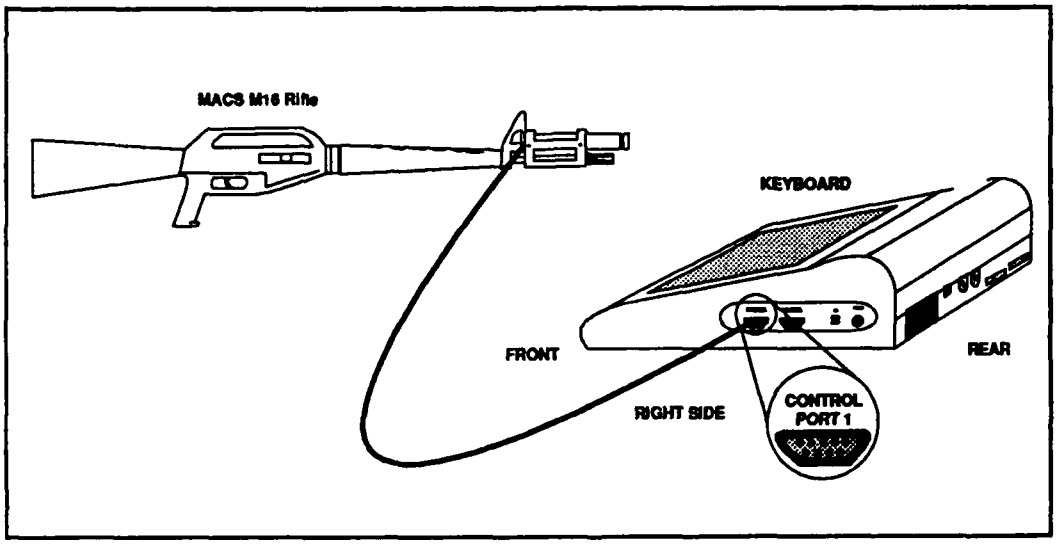


STEP 6 M16 CABLE PLUG

- Plug MACS M16 rifle light pen cable into control port 1 slot found on right-hand side of keyboard.

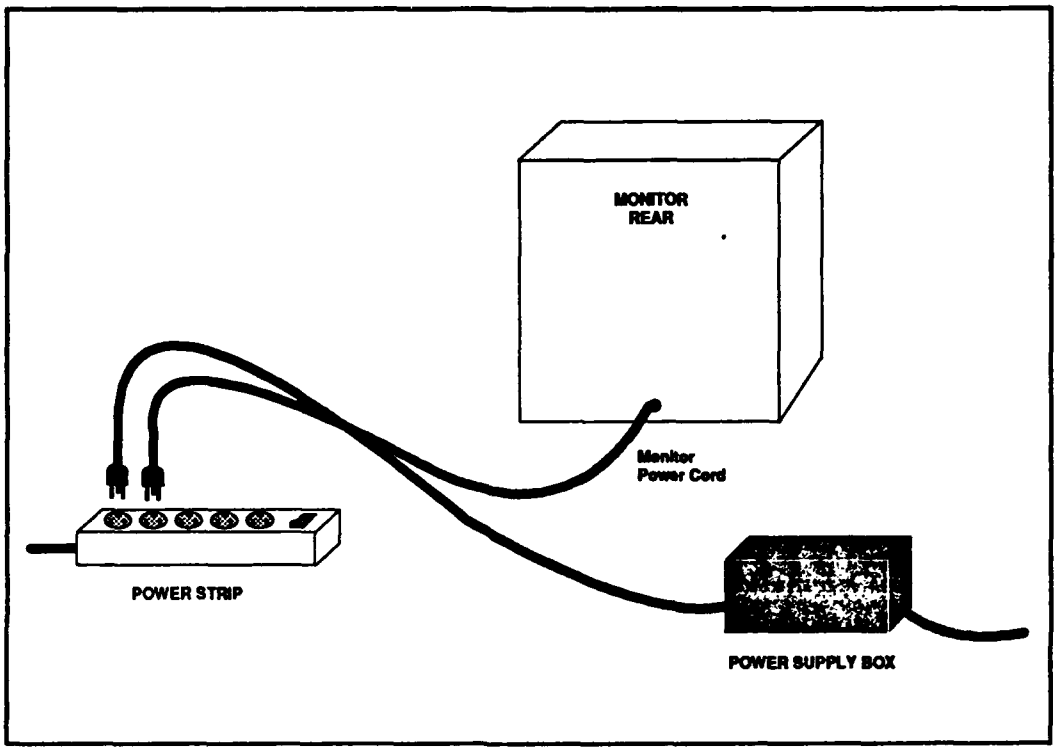
CAUTION:

PLUG ONLY FITS ONE WAY!



STEP 7 PLUG POWER CORDS INTO OUTLET

- Plug in three-pronged AC power cord from power supply box.
- Use of a surge protector power strip is strongly recommended.
- Plug in monitor power cord.
- Monitor power cord is found on bottom rear of monitor.



STEP 8 TURN ON THE SYSTEM

Turn **on** components of system in following order.

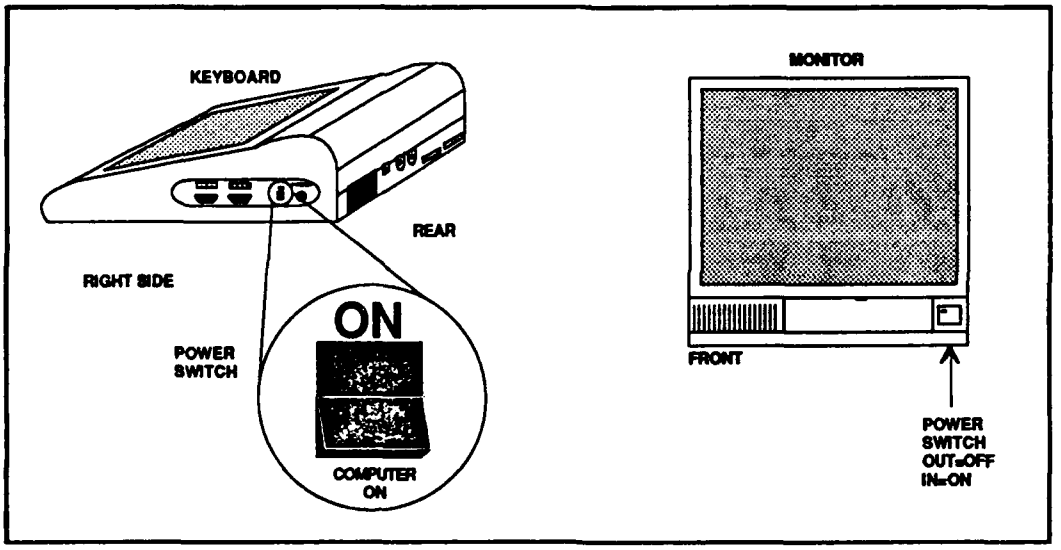
1. **Computer**: switch located on right side of keyboard
2. **Monitor**: switch located on bottom right front

Commodore (Model 1802)

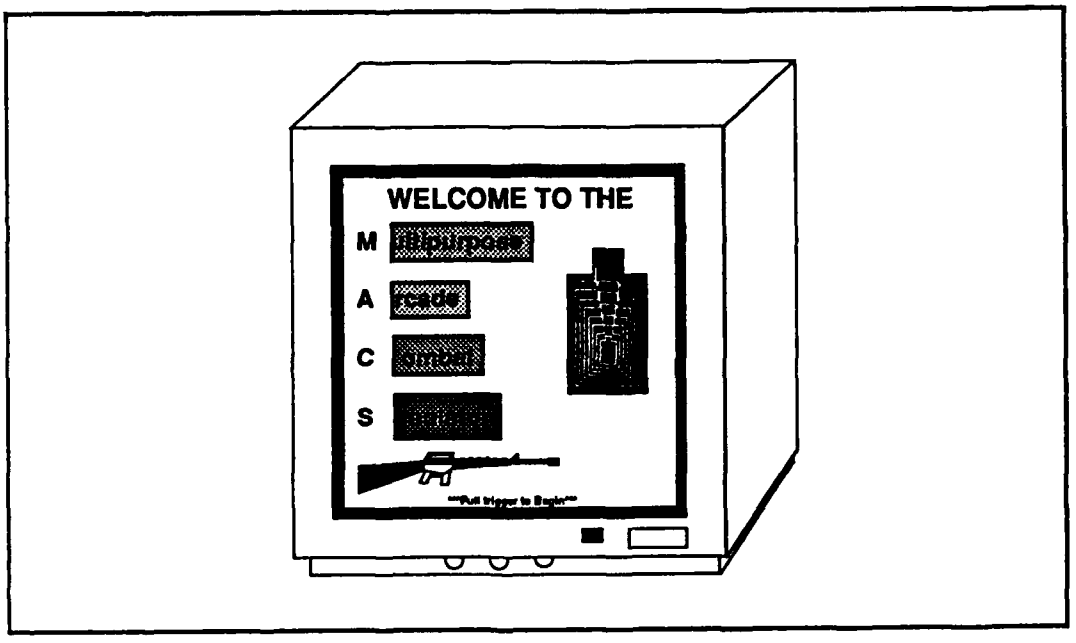
- Adjust BRIGHT to halfway between maximum and minimum (detent).
- Adjust COLOR and CONTRAST to detent.
- Adjust VOLUME to halfway.

Hitachi

- Adjust BRIGHT and CONTRAST to maximum (clockwise).
- Adjust VOLUME and COLOR to detent.



- The MACS Welcome Screen should appear in color and with sound.
- IF NOT REFER TO TROUBLESHOOTING TIPS IN SECTION 5.



LIGHT PEN MOUNT ALIGNMENT

NOTE:

The MACS system light pen mount occasionally may need to be realigned. The only tool needed is an allen wrench (9/64" for demilitarized rifle or 5/64" for M16 replica rifle).

Older MACS systems have an adjustable focal ring on the light pen. An incorrect gap is the most frequent and easily corrected problem if the light pen is not reading the computer screen (detected by a purple border). On these systems, always check to ensure the gap between the focal ring and light pen barrel is approximately 5/8", before attempting to adjust the light pen mount.

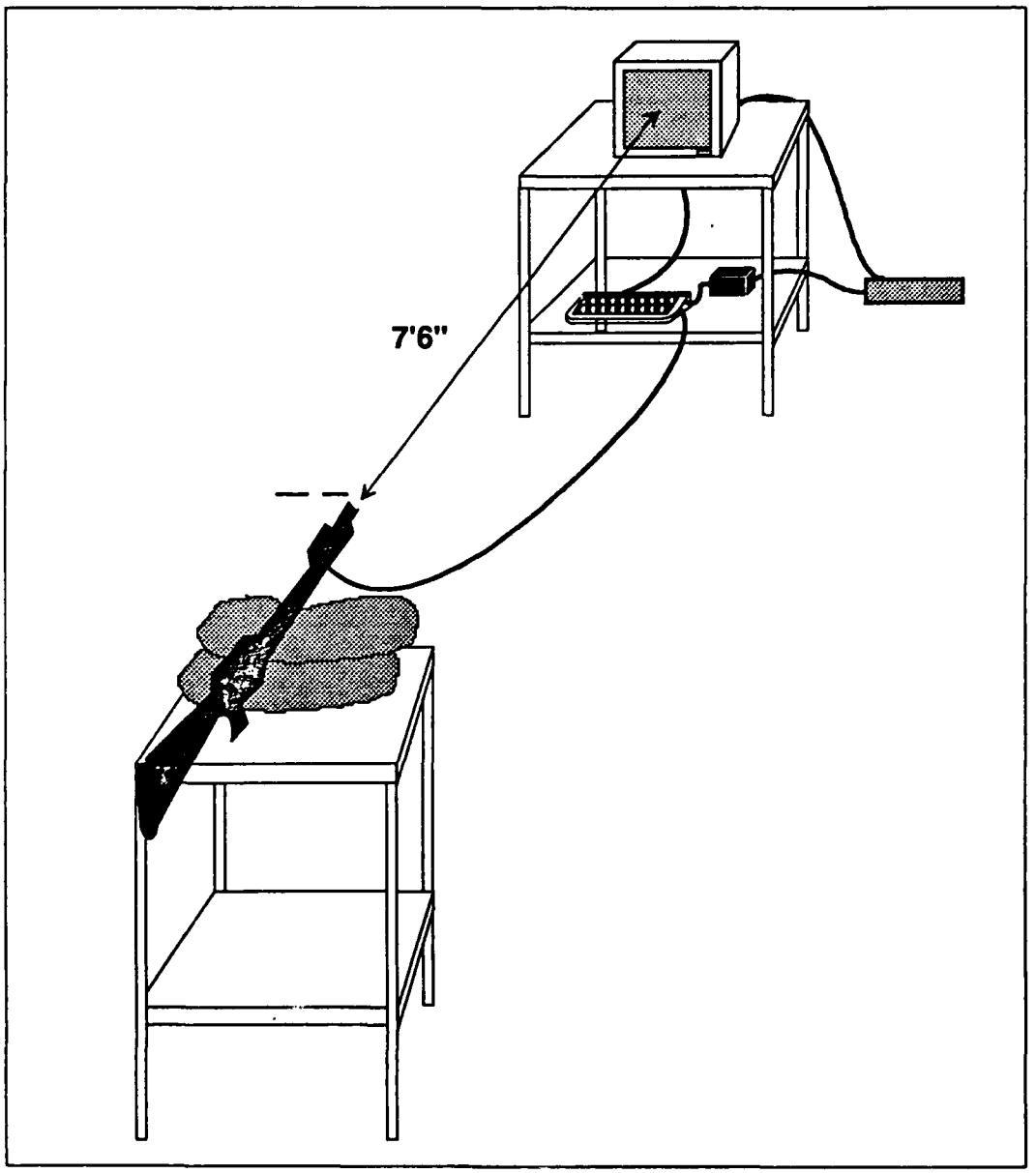
Detailed instructions for adjusting the light pen mount are provided in section 2 of this guide.

LIGHT PEN MOUNT ALIGNMENT

NOTE:

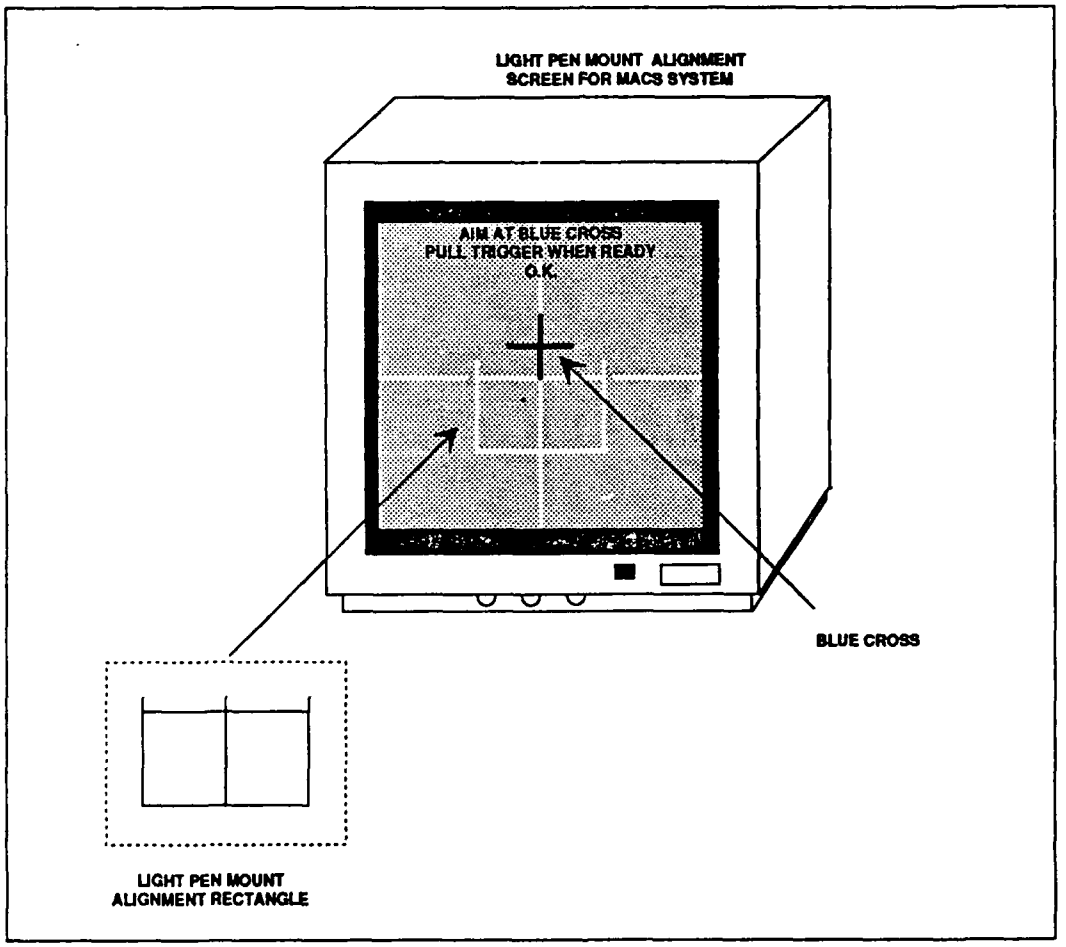
BEFORE PROCEEDING WITH ALIGNMENT OF LIGHT PEN MOUNT

- **Place rifle 7'6" from screen.**
- **Turn on computer.**
- **The MACS Welcome Screen will appear.**

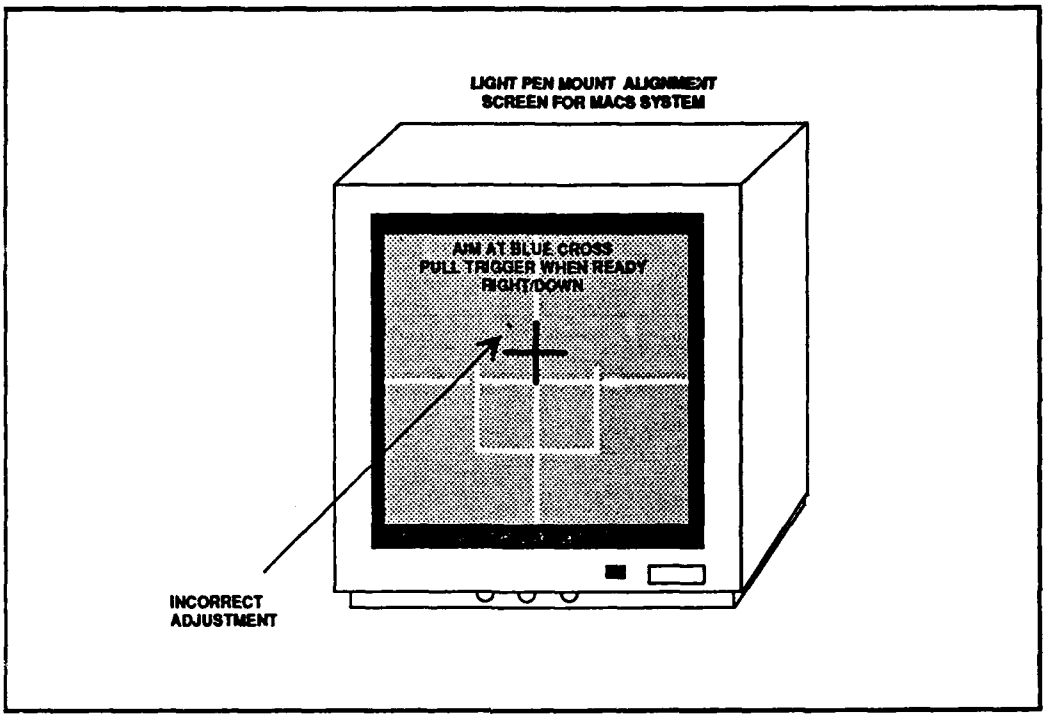


STEP 1 CHECK ALIGNMENT OF THE LIGHT PEN MOUNT

- Type LP at MACS welcome screen or;
- Press RUN STOP to enter MACS menu.
- Type letters **LP** then RETURN to start light pen mount alignment program.
- Aim at center of blue cross and pull trigger.
- **While holding rifle steady look over sight.**
  - If light pen mount alignment is correct, **O.K.** will appear on the screen and black dot will appear in rectangle.
- Go to **STEP 3.**



IF BLACK DOT IS NOT IN ALIGNMENT RECTANGLE AND O.K. DOES NOT APPEAR LIGHT PEN MOUNT NEEDS ADJUSTMENT. GO TO STEP 2.



STEP 2 LIGHT PEN MOUNT ADJUSTMENT

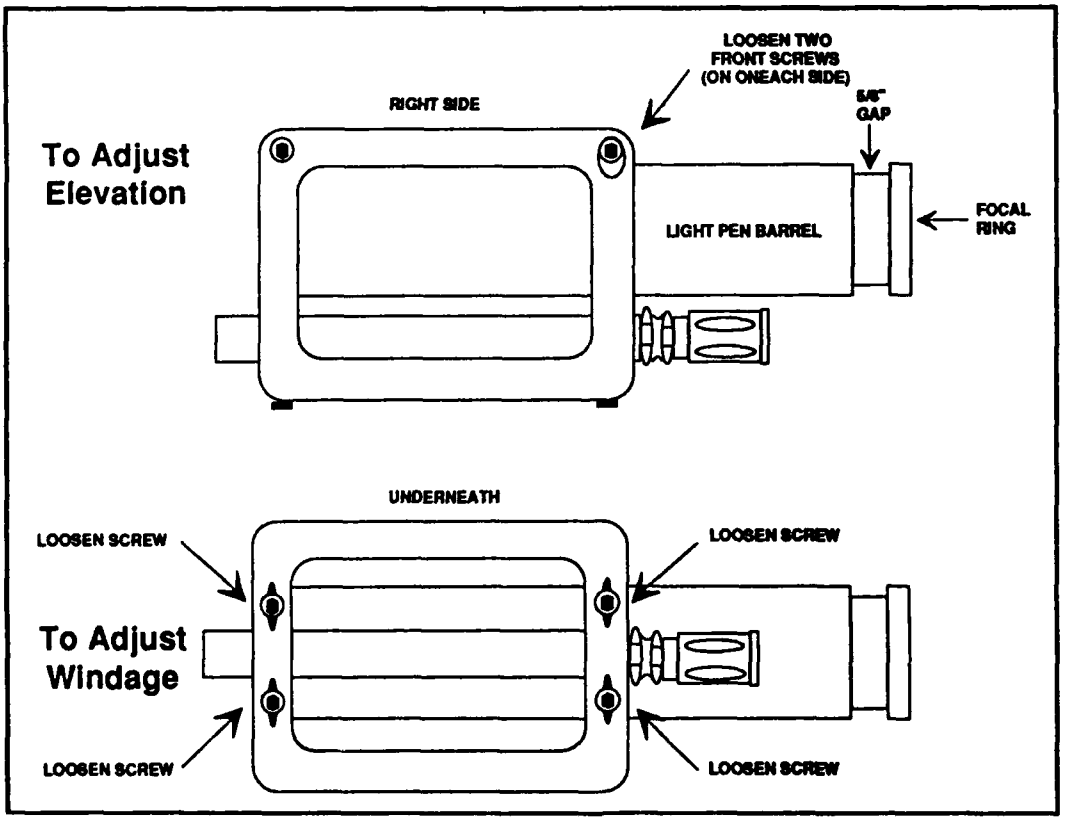
LIGHT PEN MOUNT ADJUSTMENT IS REQUIRED ONLY IF THE BLACK DOT DOES NOT APPEAR WITHIN THE ALIGNMENT RECTANGLE WHEN RIFLE IS AIMED AT CENTER OF BLUE CROSS.

NOTE:

For light pen mount adjustment two people are recommended unless a vise is available to hold rifle securely.

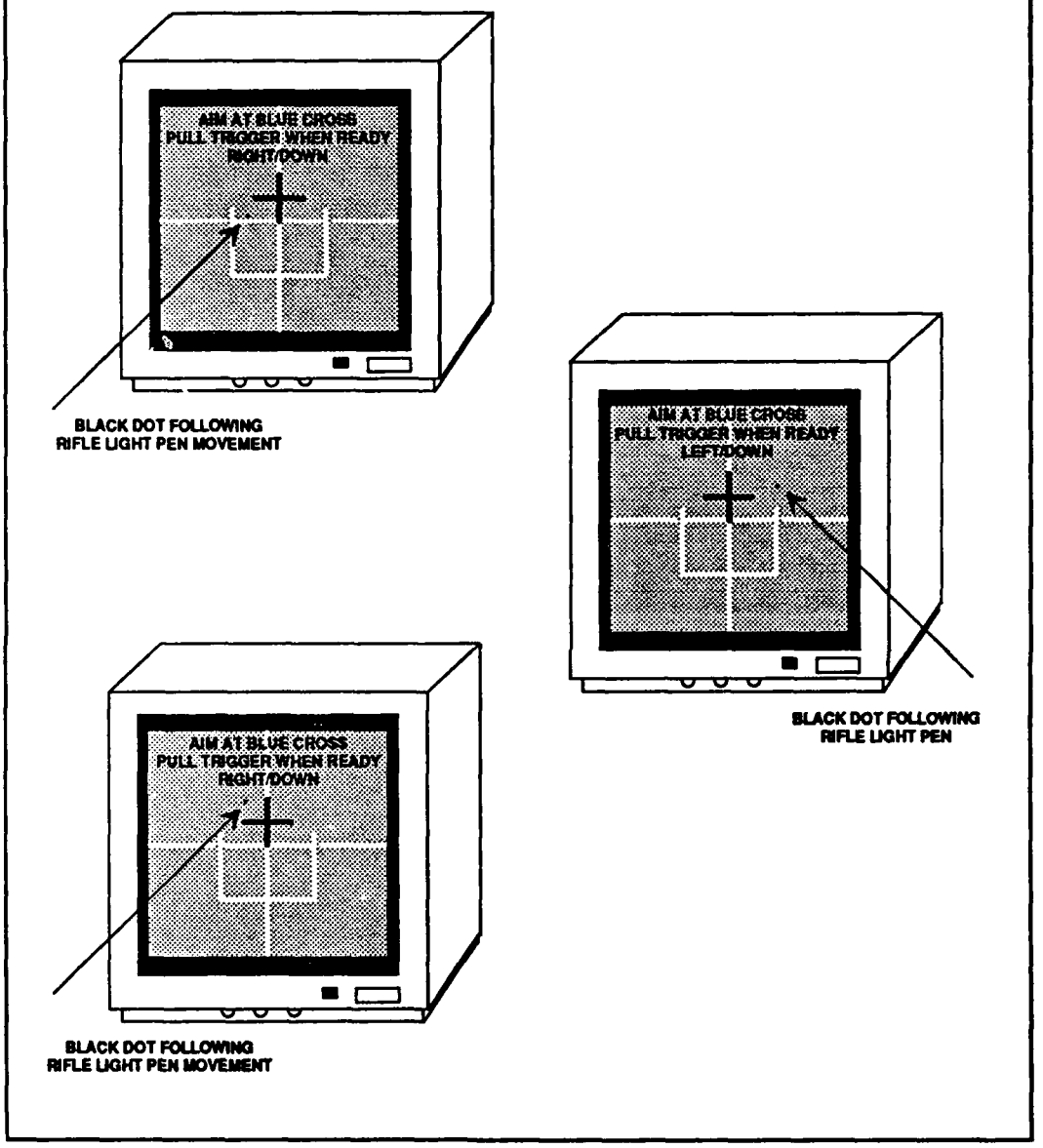
- For light pens with adjustable focal rings:
  - Ensure gap between focal ring and light pen barrel is 5/8".

  Loosen screws on light pen mount.
  - 9/64" for demilitarized M16 rifle.
  - 5/64" for replica M16 rifle.
- Holding rifle securely, aim rifle at center of blue cross.
- Adjust light pen mount to move black dot into rectangle.
- When O.K. appears, tighten screws on light pen mount.
- If this does not work; see trouble shooting in section 5.



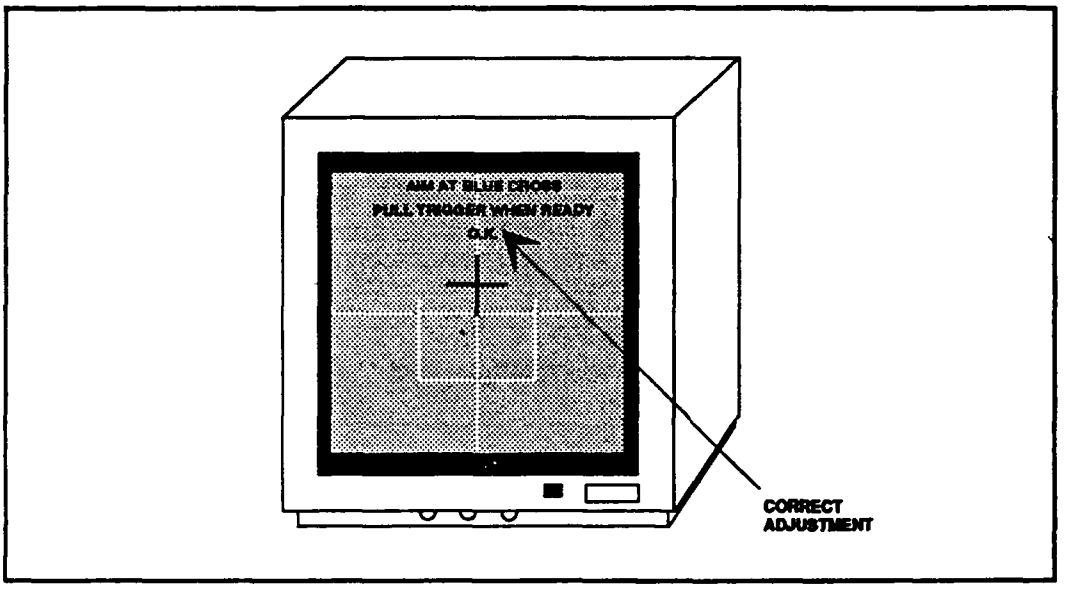
STEP 3 PERFORM LIGHT PEN TRACKING TEST

- Look over the rifle sights at the monitor screen.
- Aim rifle toward different points on screen.

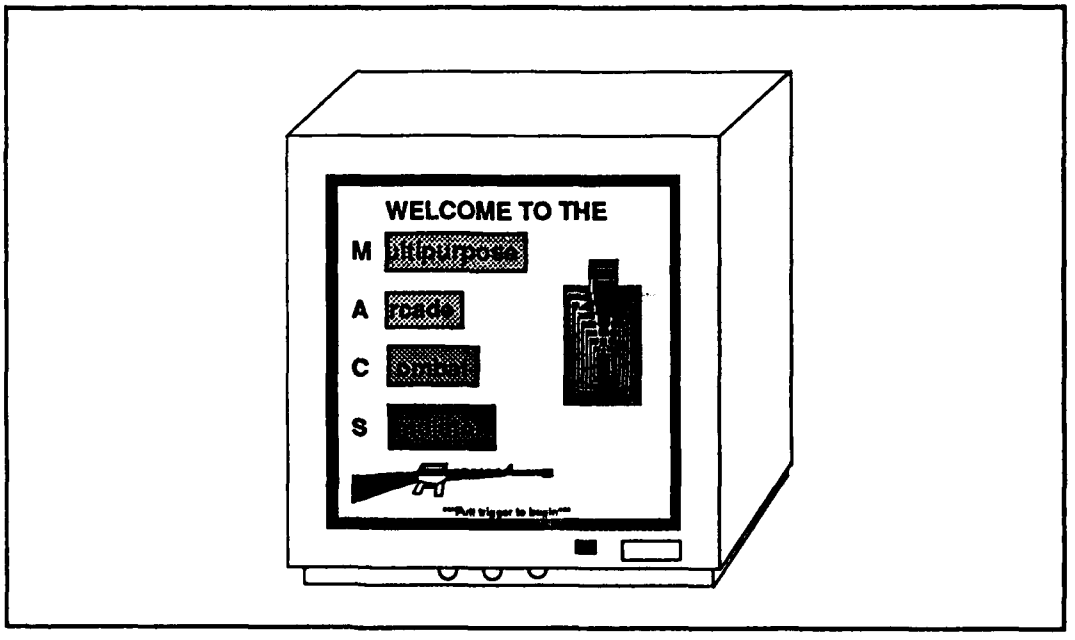


IF BLACK DOT SMOOTHLY FOLLOWS MOVEMENT OF RIFLE, LIGHT PEN MOUNT ALIGNMENT PROCEDURE IS COMPLETE!

LIGHT PEN MOUNT ALIGNMENT IS CORRECT WHEN:
- O.K. APPEARS ON SCREEN
- BLACK DOT APPEARS IN RECTANGLE



Pull trigger to return to MACS Welcome Screen



THE BASIC RIFLE MARKSMANSHIP PROGRAM

OVERVIEW OF MACS SYSTEM AND BRM PROGRAM

MACS system is a low-cost, part-task weapons trainer that has been validated as a teaching device with entry-level soldiers. The system may be used for basic, preparatory, sustainment, and remedial training.

The MACS system has four parts:

1. **An M16 demilitarized or replica rifle with a light pen attached to the barrel;**
2. **A Commodore 64 computer;**
3. **A computer monitor; and**
4. **The BRM software cartridge designed for use with the M16 rifle.**

MACS allows soldiers to practice Basic Rifle Marksmanship (BRM) skills by firing at targets at scaled ranges displayed on a computer screen. Diagnostic feedback is provided on the screen.

The program written for the MACS system provides part-task training in BRM. A skill test is followed by a main program which has nine increasingly more difficult levels of training. Stationary targets at ranges between 50 and 300 meters are presented at varying time intervals depending on the level being practiced. Specific performance standards are set for each level, and are incorporated into the program. Upon completion of a level, the shooter's performance is evaluated against these standards.

Depending on performance the shooter may:

1. **Advance to the next level;**
2. **Stay at the same level; or**
3. **Be sent back one level.**

The MACS BRM program is specifically designed to help the average and below average shooter, and does this in two ways:

- **First, it provides the shooter with more feedback than can be obtained from live fire on a range.**

- **Second, because the rifle has no flash, recoil, or cartridge ejection system, it allows the shooter to develop the psycho-motor skills needed to achieve steady position, correct aiming, breath control, and control of the weapon at trigger closure, without having to overcome the instinct to flinch or blink when a weapon is fired.**

MACS provides additional flexibility, allowing the instructor to go directly to any level using the MENU. Other OPTIONS include introducing wind of different speeds and directions into any of the nine levels, and a "call your shot" routine. **A list of options and menu instructions are found in section 4.**

The MACS system software is largely self-explanatory, but assumes the presence of an instructor. It is designed to enable a sergeant to train a squad. On-screen diagnostic feedback is provided to the shooter, which helps the instructor in identifying problems, and recommending corrective action.

At the first four levels, shot-by-shot feedback is provided:

- **Steady position**
- **Breath control**
- **Aiming**
- **Trigger squeeze**
- **Shot location**
- **Replay of sight picture**

At all levels summary feedback is provided:

- **Single target shot groups for each range.**
- **Average diagnostic scores or a summary of shots is presented at the end of each level.**

The type of feedback provided at each level of difficulty is summarized beginning on page 3-17.

The MACS BRM program has incorporated features to enable a single instructor to monitor the progress of several soldiers at the same time (with multiple systems). Standards embedded in the program determine the shooter's progress from level to level.

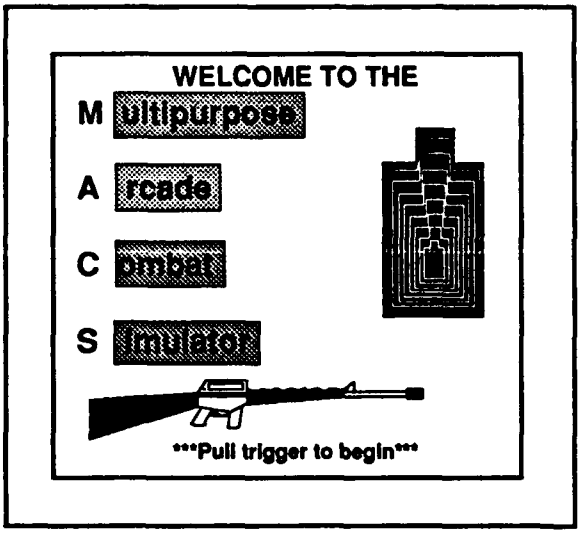
The color of the screen border changes to draw the instructor's attention to any soldier having difficulty. The colors of the borders indicate the soldier's status:

- **BLACK - Making satisfactory progress.**
- **RED - Refiring some targets at a particular range, or a part of a level.**
- **BLUE - Refiring an entire level.**
- **YELLOW - Has been sent back one level.**
- **PURPLE - Aiming off the screen, or light pen not reading.**

Information on the soldier's progress is included in the upper left corner of the screen.

- **L - Level being shot.**
- **T - Target being shot within a level.**
- **R - Number of refires within a level.**

Before using the MACS system as a teaching device with soldiers, the instructor should read the MACS Trainer's Guide and shoot the entire program several times.

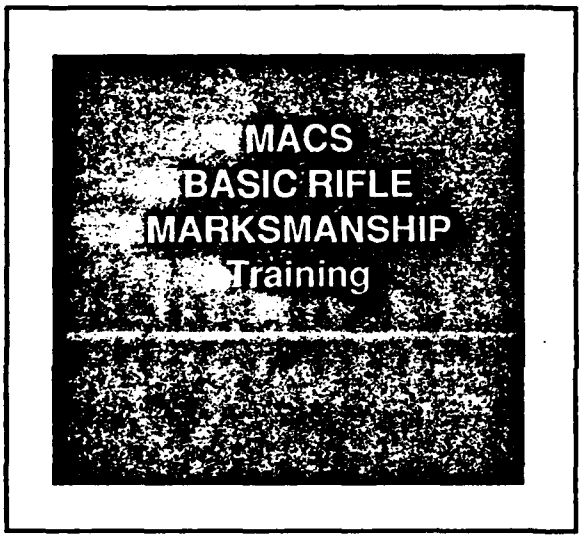


MACS WELCOME SCREEN

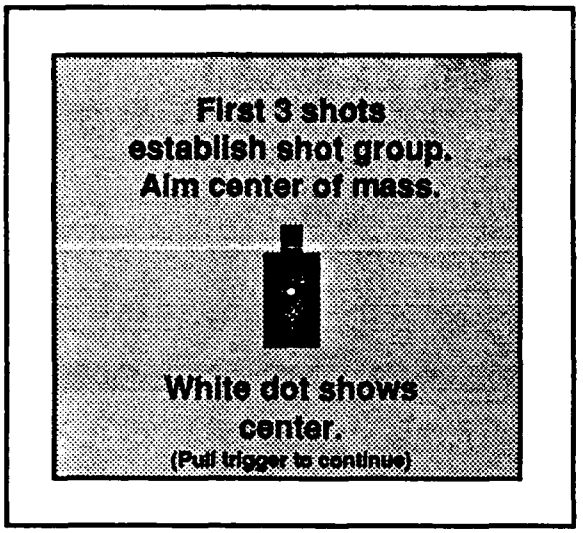
- First screen of MACS BRM program.
- Adjust volume.
- Pull trigger to begin program.

or

Press RUN STOP key to access MACS program menu (see section 4).



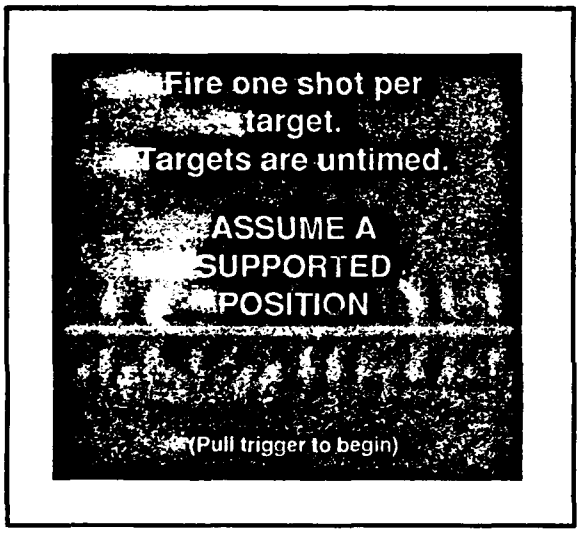
NOTE: 2 on keyboard will substitute for trigger pull on screens not showing targets.



ESTABLISH SHOT GROUP

- It is important to get a good shot group.
- Targets are at 250m.

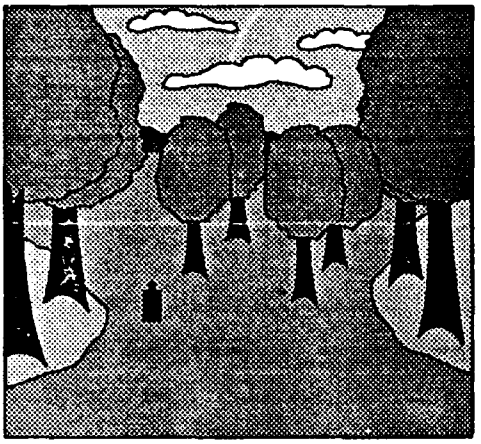
NOTE: Adjustment of brightness or contrast after establishing shot group changes system calibration (firer must rezero).



SHOOTING INSTRUCTIONS

- The three shots establish shot group.

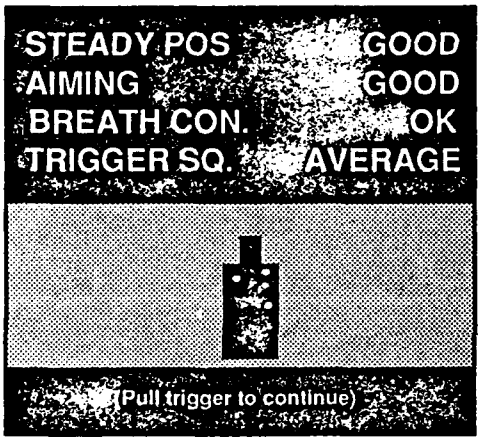
NOTE: Pulling rifle trigger sends signal to computer to continue.



FIRE SHOT GROUP

- Soldier fires one shot at each of three targets.

NOTE: Purple border appears when light pen is not aimed at screen.



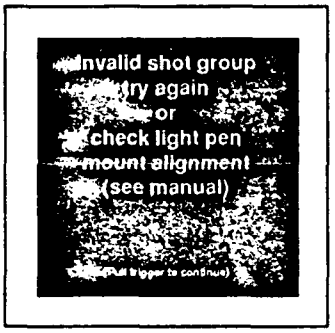
SHOT GROUP SUMMARY SCREEN

- Shot locations pictured on target.
- Feedback for three shots summarized.
- Good shot group calibrates system.

IF SHOT GROUP IS INVALID:

- An invalid shot group is one in which one or more shots hit outside a rectangular area (not seen by the shooter) which is the same size as the light pen mount alignment rectangle shown on the next page.

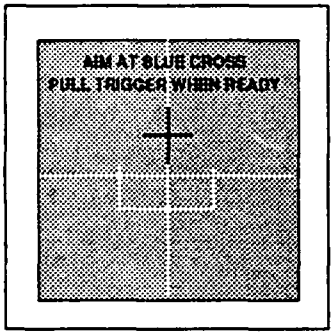
IF SECOND SHOT GROUP IS INVALID:



If second shot group is invalid:

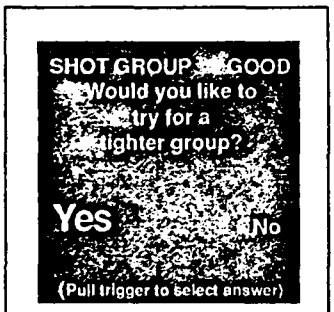
- Press RUN / STOP on Keyboard to start light pen mount alignment program.

NOTE: See section 2 for instructions on aligning the light pen mount.



- Follow directions for alignment.
- Following alignment the program will return to WELCOME TO MACS screen.

IF SHOT GROUP IS VALID:

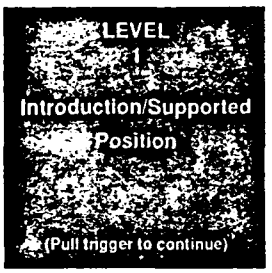


- Pull trigger when selected answer (YES or NO) is enlarged.
- If **YES**:
  Refire shot group.
- If **NO**:
  Initial skill test criteria determine starting level.

INITIAL SKILL TEST CRITERIA

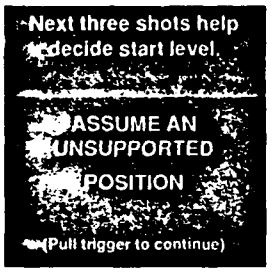
To pass each skill test two GOOD ratings and two EXCELLENT ratings must be earned on measures of shot location, steady position, aiming, and trigger squeeze.

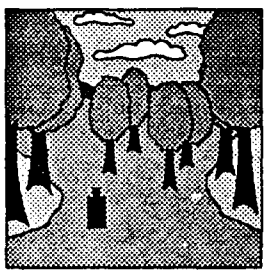
IF CRITERIA ARE NOT MET:



- Program starts at Level 1.
- See page 3-12.

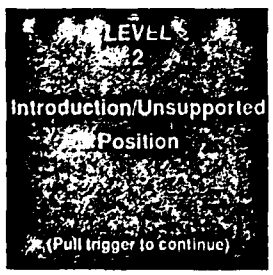
IF CRITERIA ARE MET:





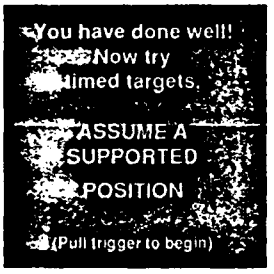
- Skill test is continued.
- Soldier fires one shot as each of three targets is presented from an unsuppported firing position.

IF CRITERIA ARE NOT MET:

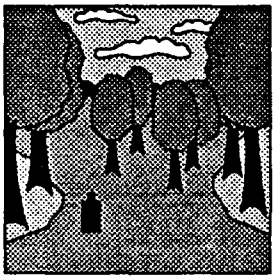


- Program starts at Level 2.

IF CRITERIA ARE MET:

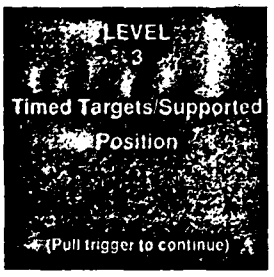


- **Skill test is continued.**
- **3 shots fired at timed targets in supported position to determine starting level for better shooters.**



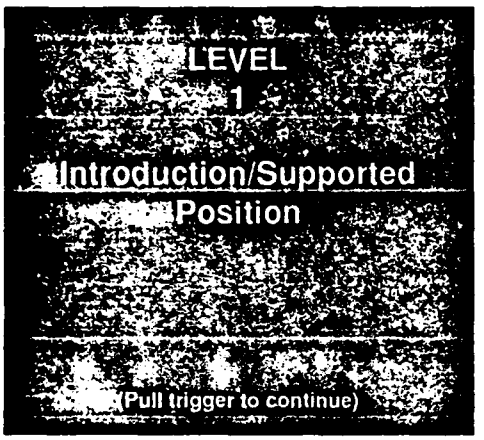
- **Timed targets at 100, 250, and 300m are presented.**

IF CRITERIA ARE NOT MET:



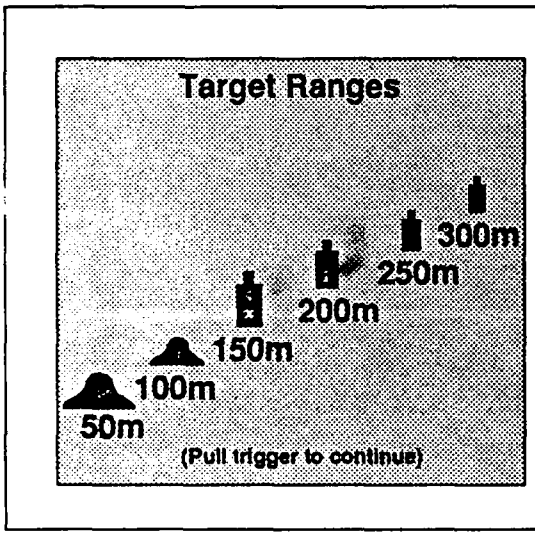
- **Program starts at Level 3.**

NOTE: If criteria are met, three shots are then fired from the unsupported position. Program can begin at Level 4 or Level 5 depending on results of this skill test.



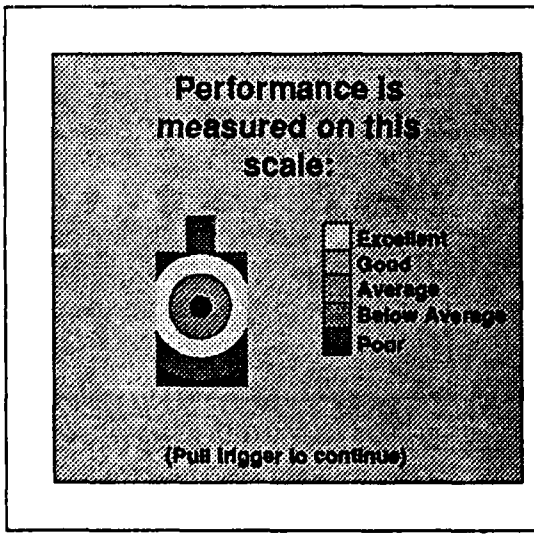
LEVEL 1

- First firing level in BRM program.



TARGET RANGES

- Targets at each range are illustrated.

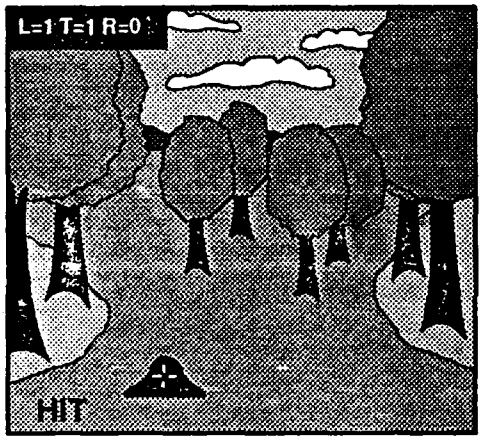


SHOT LOCATION STANDARDS

- The shooter must hit center of mass for shot location to be graded excellent.

SHOOTING INSTRUCTIONS

- Untimed targets.
- Hit 2 of 3 at each distance.
- Supported position.
- First three targets are at 50 meters.



TARGET SCREENS

- Three target screens are presented.
- Feedback screens follow each target presentation.

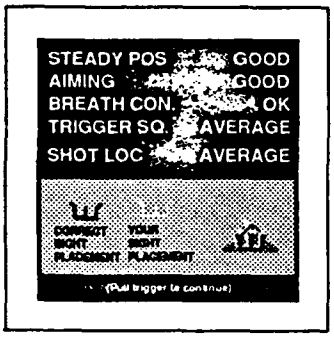
  indicates bullet strike.
- HIT or MISS appears in lower left *corner of screen.*

NOTE: In the upper left corner of the screen:
- L=Level being shot.
- T=Target being shot within a level.
- R=Number of refires within a level.

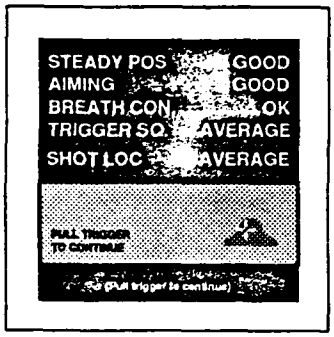
FEEDBACK SCREEN SEQUENCE

correct sight placement (black).

your sight placement (white).

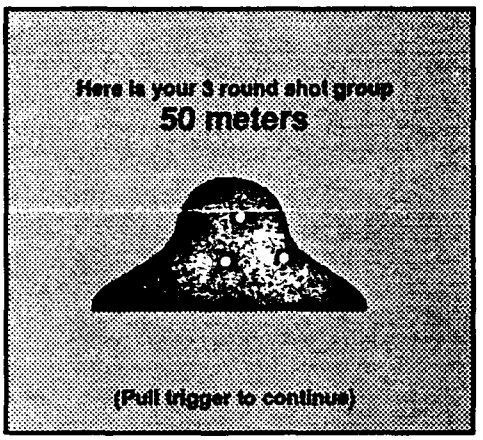


- Each shot is followed by a replay of the sight placement of the shooter compared to the correct sight placement, and bullet strike.
- Shooter's sight placement in moments before bullet strike (white) is superimposed over correct sight placement (black).
- The shot can be replayed as many times as necessary.



- PULL TRIGGER TO CONTINUE to next target screen.
- Bullet strike is displayed on target.

NOTE: For an explanation of MACS Feedback turn to page 3-17.



3 ROUND SHOT GROUP

- Target and feedback screens repeated for 100, 150, 200, 250, and 300m targets.
- Shot group displayed on target at each range.
- These screens can be analyzed as if shots were fired at a known distance (KD) range.
- Must hit 2 of 3 targets to meet standard.

TRAINER'S TIP

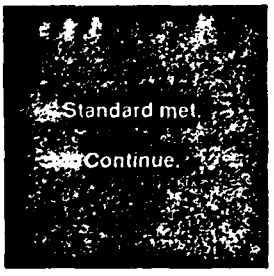
Trainer should assist the soldier by performing a shot group analysis, & give corrective action.

For example, the soldier's shot group at 100m is centered horizontally, but is too high.
Corrective action: explain adjusted aiming point.

FAILURE TO MEET STANDARD

- Repeats presentation of target and feedback screens for each of the 3 shots.
- 3 round shot group is displayed for the range.

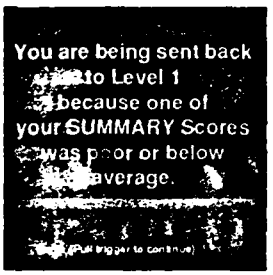
NOTE: Red border appears during refire of a range.



- This screen appears following refire at a specified range.
- Border color will return to black as program continues.

- If standard is met the shooter goes on to Level 2.

STANDARD FOR LEVEL 1 NOT MET



- Blue border will appear during refire of a level.
- Yellow border will appear if shooter has regressed from a higher level.

Summary Description of Levels

Level 1: Introduction to Supported Position

Summary description

- No time limit.
- Supported position.
- Single-target presentations.
- Eighteen targets presented, three targets at each of six ranges.
- Targets engaged in order of range: 50, 100, 150, 200, 250, and 300 m.

Feedback

- Words **HIT** or **MISS** appear on screen for each shot.
- Cross hair appears on screen to show bullet strike.
- Diagnostics and replay are shown after each shot.
- Screen shows 3 rounds on single target after each group of three shots.
- Summary screen at end of level shows average diagnostic scores.

Standards

- Two hits out of three shots at each range within level. Failure to meet standard at a given range results in immediate refire of 3 more targets at that range. Refires continue until standard is met.
- Refire of level is required if any score on summary screen is **BELOW AVERAGE** or **POOR.**
- Breath control is rated **OK** or **CHECK.** These ratings are tied to the steady position score.

Level 2: Introduction to Unsupported Position

Identical to Level 1, with these exceptions:

- It is fired in the unsupported position.
- Shooter is regressed a level if any 2 scores on summary screen are **POOR.**

Level 3. Timed Targets in Supported Position

Summary description

- Time limit approximately 1 1/3 times that of record fire.
- Supported position.
- Single target presentations.
- Twenty-four targets in random sequence (four presentations per range).

Feedback

- Cross hair appears on screen to show bullet strike.
- For a hit, target disappears immediately after bullet strike is shown.
- Diagnostics and replay are shown after **bad shots** only. Criteria for **bad shot** is a POOR for any score or a BELOW AVERAGE for shot location.
- Audible tone when target exposure time limit has expired.
- Summary screen at end of level showing average diagnostic scores.
- Summary screens showing four shots at each range on single targets.

Standards

- Three hits out of four shots at each range within level. For each range at which this standard is not met, a refire of four targets at each of those ranges is required. Refires continue until standard is met.
- Refire of level is required if any score on summary screen is BELOW AVERAGE or POOR.
- Shooter is regressed a level if any two scores on summary screen are POOR.

Level 4. Timed Targets in Unsupported Position

Identical to Level 3, with these exceptions:

- Level 4 is fired in the unsupported position.
- Standard is lower. Three hits out of four shots at 50, 100, 150, and 200 m, and two hits out of four shots at 250 m and 300 m.

Level 5. Practice Record Fire I

Summary description

- Time limit same as for record fire.
- Supported and unsupported positions.
- Single or double presentations.
- Targets presented in random sequence.
- 20 targets fired supported, then 20 fired unsupported.

Feedback

- Cross hair appears on screen to show bullet strike.
- For a hit, target disappears after bullet strike is shown.
- Audible tone when target exposure time limit has expired.
- OUT OF AMMO appears on screen when 20 shots have been fired.
- Interim summary of performance (hits, misses, and no fires) and shot location score given at end of each position and final summary at end of course of fire.
- Summary screens showing shots at each range on a single target at end of supported position and at end of unsupported position.
- Overall performance is graded Expert (36-40), Sharpshooter (30-35), Marksman (23-29), or Unqualified (0-22).

Standards

- Fifteen hits out of 20 shots in both supported and unsupported positions. Refire of position if standard not met.
- On double target exposures, a penalty is recorded if furthest target is engaged first (a penalty indicates a tactical error, but does not reduce the total number of hits).
- Regress one level for shot location score of POOR. Stay at same level for mean shot location score of BELOW AVERAGE. Otherwise pass.

Level 6. Practice Record Fire II

Identical to Level 5, with the exception that the cross hair showing bullet strike appears only after misses. Target disappears when hit.

Level 7: Record Fire

Summary description

- Time limit same as actual live-fire qualification course.
- Supported and unsupported positions.
- Single or double presentations.
- Targets presented in random sequence.
- 20 targets fired supported, then 20 fired unsupported.

Feedback

- Targets disappear when hit.
- **OUT OF AMMO** appears on screen when 20 shots have been fired.
- Audible tone when target exposure time limit has expired.
- Cross hairs showing bullet strike for misses on refires only.
- Interim summary of performance (hits, misses, and no fires) and shot location score given at end of each position and final summary at end of course of fire.
- Summary screens showing shots at each range on a single target at end of supported position and at end of unsupported position.
- Overall performance is graded Expert (36-40), Sharpshooter (30-35), Marksman (23-29), or Unqualified (0-22).

Standards

- Fifteen hits out of 20 shots in both supported and unsupported positions. Refire of position if standard not met.
- On double target exposures, a penalty is recorded if furthest target is engaged first.
- Regress one level for average shot location score of POOR. Stay at same level for mean shot location score of BELOW AVERAGE. Otherwise pass.

Level 8: Rapid Record Fire

Identical with Level 7, except that the exposure times of targets are 2/3 of those used in record fire.

Level 9: Combat Fire

Summary description

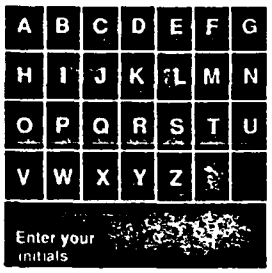
- Time limits variable, dependent on number of targets presented.
- Supported and unsupported positions..
- Single, double, and multiple presentations.
- Eighty targets in two attack/retreat scenarios each of 40 targets. First scenario is fired supported and second unsupported.

Feedback

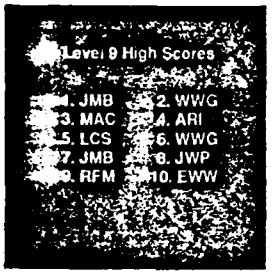
- Targets disappear when hit.
- **OUT OF AMMO** appears on screen when 40 shots have been fired.
- Cross hairs showing bullet strike for misses on refires only.
- Summary of shot location (hits, misses, and no fires) given at end of supported position and at end of unsupported position.
- Summary screens showing shots at each range on a single target at end of supported position and at end of unsupported position.
- Performance graded as Expert (36-40), Sharpshooter (30-35), Marksman (23-29), or Unqualified (0-22).

Standard

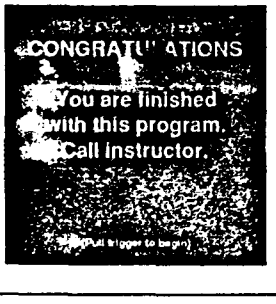
- Twenty-three hits out of 40 shots in both supported and unsupported positions. Refire of position if standard not met.



- At the end of Level 9, combat fire, high scorers may enter initials for display on high score screen. The high score screen will alternate with the MACS welcome screen until computer is turned off.



- Alternates with MACS welcome screen
- Activated after shooter fires high score on Level 9.



NOTE:

The following charts provide a summary of the MACS BRM Cartridge.

MACS FEEDBACK FOR BRM CARTRIDGE

	SHOT-BY-SHOT DIAGNOSTIC FEEDBACK		ON-SCREEN FEEDBACK DURING SHOOTING									
LEVEL	Diagnostic feedback and replay of each shot.	Diagnostic feedback for poor shots only.	Hit or miss in lower left corner of screen.	Cross hairs showing bullet strike.	Whistle signals target not hit within time limit.	Target disappears when hit.	Out of ammo in lower right corner of screen.	Penalty for not hitting closest target first.	Shot group displayed on target at each range.	Average diagnostic scores at end of each level.	Summary of hits, misses, and no fires.	Qualification ratings.
1	X		X	X					X	X		
2	X		X	X					X	X		
3		X		X	X	X			X	X		
4		X		X	X	X			X	X		
5				X	X	X	X	X	X		X	X
6				X*	X	X	X	X	X		X	X
7				X**	X	X	X	X	X		X	X
8				X**	X	X	X	X	X		X	X
9				X**		X	X		X		X	

*FOR MISSES ONLY
**FOR MISSES ON REFIRES ONLY

MACS BRM CARTRIDGE

LEVEL	TITLE	TIME LIMIT	POSITION	TARGET PRESENTATION	TARGET SEQUENCE	NUMBER OF TARGETS	STANDARDS
1	INTRODUCTION TO SUPPORTED POSITION	NONE	SUPPORTED	SINGLE	IN ORDER 50-100-150-200-250-300	18 (3 PER RANGE)	HIT 2 OF 3 TARGETS AT EACH DISTANCE
2	INTRODUCTION TO UNSUPPORTED POSITION	NONE	UNSUPPORTED	SINGLE	IN ORDER 50-100-150-200-250-300	18 (3 PER RANGE)	HIT 2 OF 3 TARGETS AT EACH DISTANCE
3	TIMED TARGETS IN SUPPORTED POSITION	1 1/3 TIMES GREATER THAN TIME ALLOWED FOR RECORD FIRE	SUPPORTED	SINGLE	RANDOM	24 (4 PER RANGE)	HIT 3 OF 4 TARGETS AT EACH DISTANCE
4	TIMED TARGETS IN UNSUPPORTED POSITION	1 1/3 TIMES GREATER THAN TIME ALLOWED FOR RECORD FIRE	UNSUPPORTED	SINGLE	RANDOM	24 (4 PER RANGE)	HIT 3 OF 4 TARGETS AT 50-100-150-200 HIT 2 OF 4 TARGETS AT 250-300
5	PRACTICE RECORD FIRE I	SAME AS RECORD FIRE	SUPPORTED/ UNSUPPORTED	SINGLE OR DOUBLE	RANDOM	40	HIT 15 OF 20 TARGETS IN EACH POSITION
6	PRACTICE RECORD FIRE II	SAME AS RECORD FIRE	SUPPORTED/ UNSUPPORTED	SINGLE OR DOUBLE	RANDOM	40	HIT 15 OF 20 TARGETS IN EACH POSITION
7	RECORD FIRE	SAME AS ACTUAL LIVE-FIRE QUALIFICATION COURSE	SUPPORTED/ UNSUPPORTED	SINGLE OR DOUBLE	RANDOM	40	HIT 15 OF 20 TARGETS IN EACH POSITION
8	RAPID RECORD FIRE	1/3 LESS THAN TIME ALLOWED FOR RECORD FIRE	SUPPORTED/ UNSUPPORTED	SINGLE OR DOUBLE	RANDOM	40	HIT 15 OF 20 TARGETS IN EACH POSITION
9	COMBAT FIRE	VARIES	SUPPORTED/ UNSUPPORTED	MULTIPLE	ATTACK/ RETREAT	80	HIT 23 OF 40 TARGETS IN EACH POSITION

DESCRIPTION OF THE MACS MENU

DESCRIPTION OF THE MACS MENU

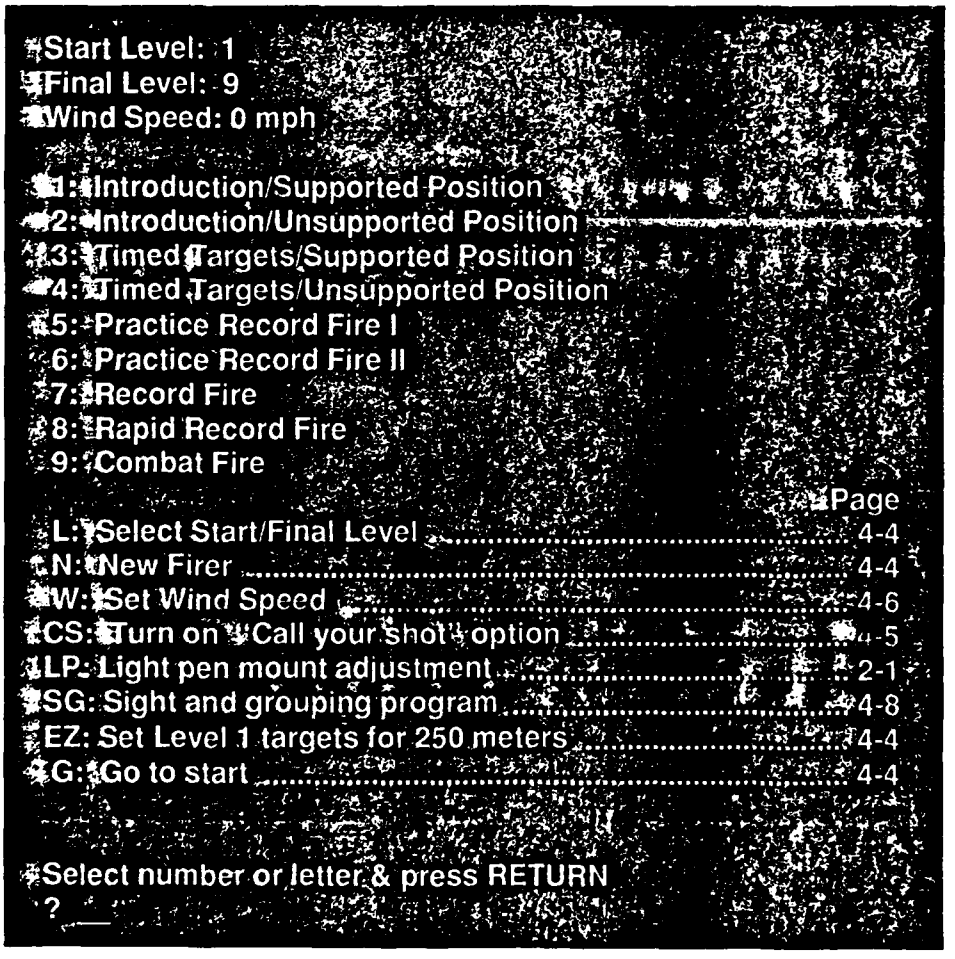
The MACS Menu provides flexibility for the instructor using the MACS program.

To access the MACS program menu, press the RUN STOP key:

- At the Welcome to MACS screen.
- At any Level screen.
- Repeatedly during a level when a target is on the screen.

DESCRIPTION OF THE MACS MENU

Instructions for using the MACS menu options are on the pages listed below.



LEVEL OPTION

- Permits instructor to set levels before students arrive.

Choose level option	→	Select letter & press RETURN ? L
Enter starting level	→	Select number & press RETURN Start level (1-9)? 4
Enter final level	→	Select number & press RETURN Final level (4-9)? 9
Begin program	→	Select letter & press RETURN ? G

NEW FIRER OPTION

- Program returns to Establish Shot Group screen.
- Used when one firer has completed firing and a new firer takes over.

→ Select letter & press RETURN
? N

EZ OPTION

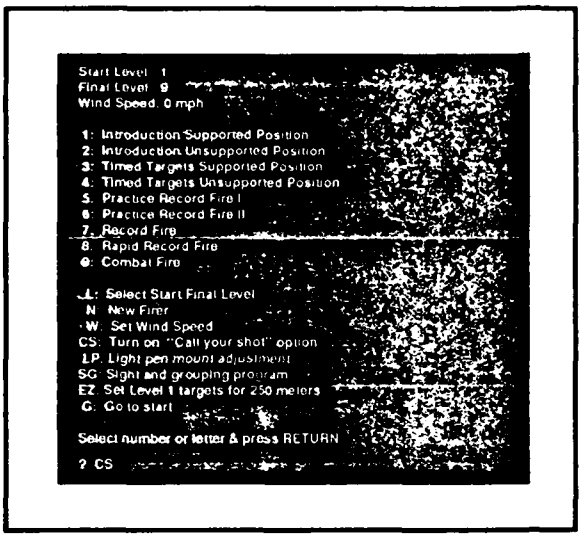
- Sets all targets in Level 1 to 250m.

→ Select letter & press RETURN
? EZ

G OPTION

- Returns user to starting or previous level.

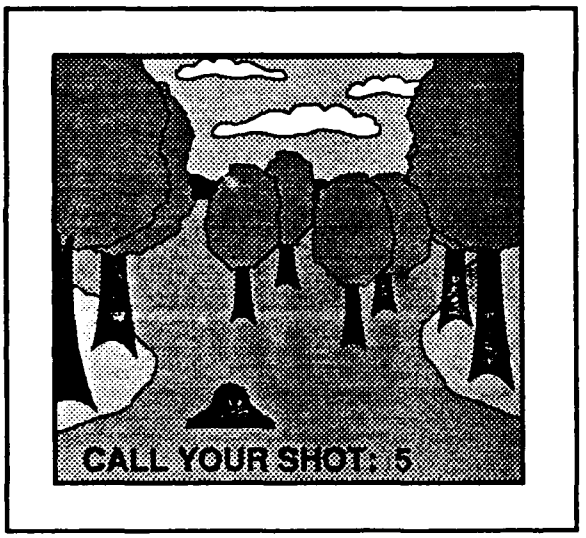
→ Select letter & press RETURN
?G



USING THE CALL YOUR SHOT OPTION

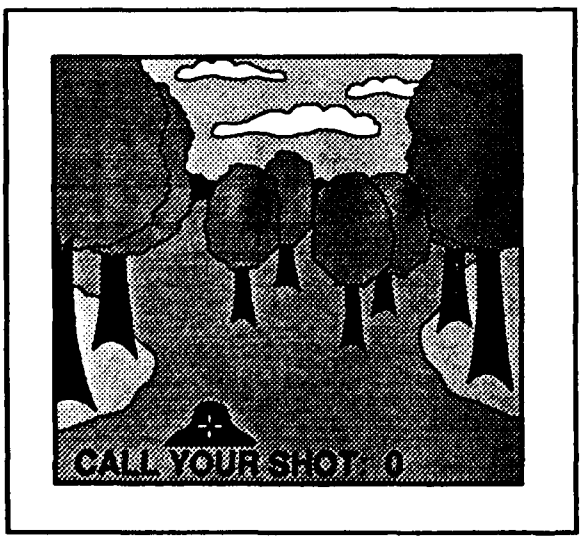
Enter: C S

NOTE: The "Call Your Shot" option works with Levels 1 and 2 only.

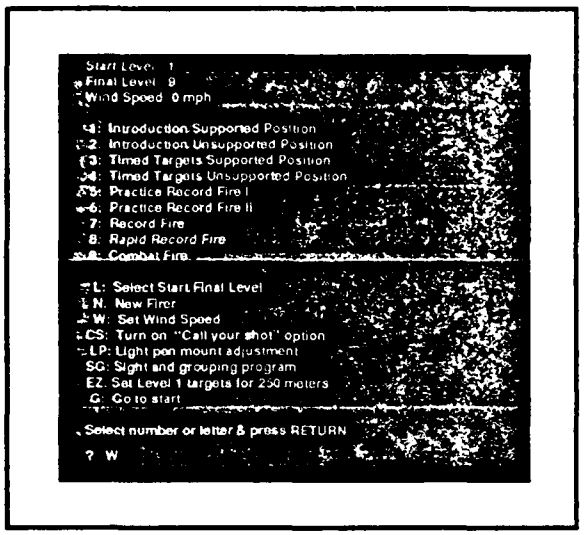


CALL YOUR SHOT

- Firer has 5 seconds to call out shot location after the trigger is pulled.
- CALL YOUR SHOT appears on the bottom of the screen.

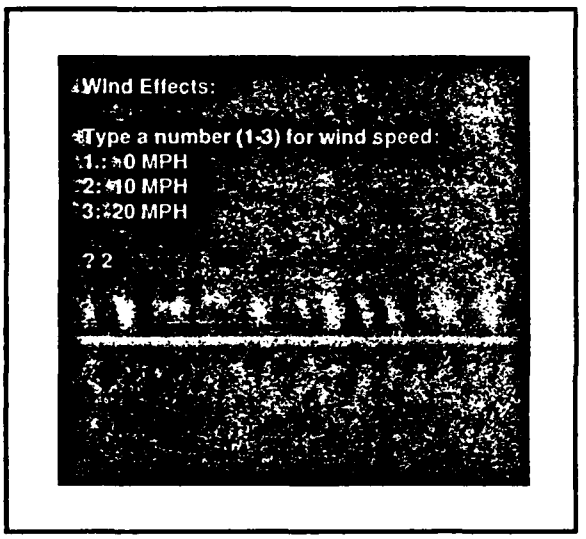


- When time expires crosshairs appear on target showing shot location.



USING THE SET WIND SPEED OPTION

· Enter **W** to select wind.

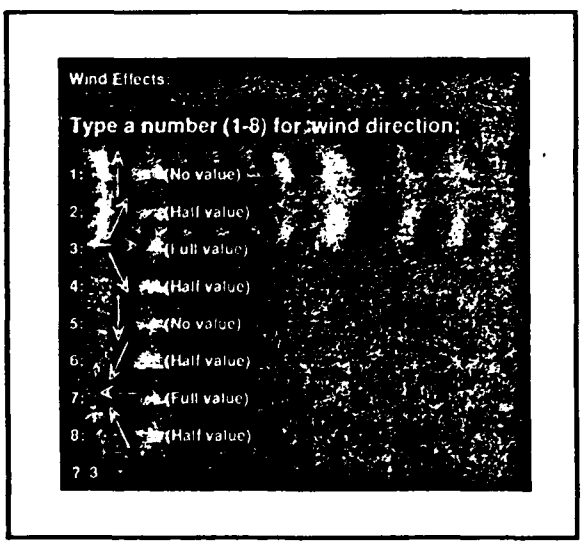


WIND EFFECTS

· Enter **1** **2** or **3**

to select wind speed.

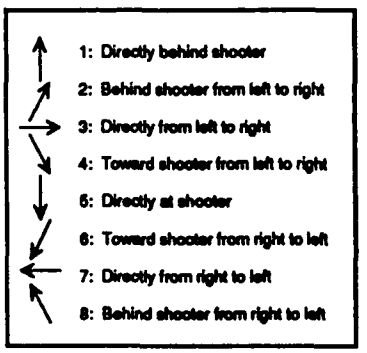
NOTE: There is no wind effect at 0 mph.

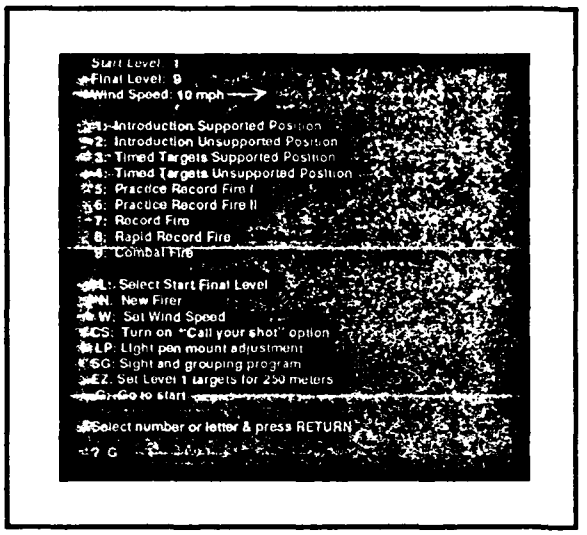


WIND DIRECTION

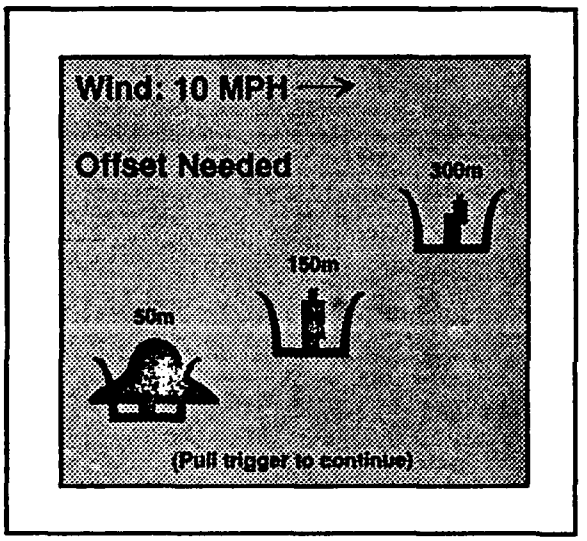
· Enter **1** to **8**

to select wind direction.





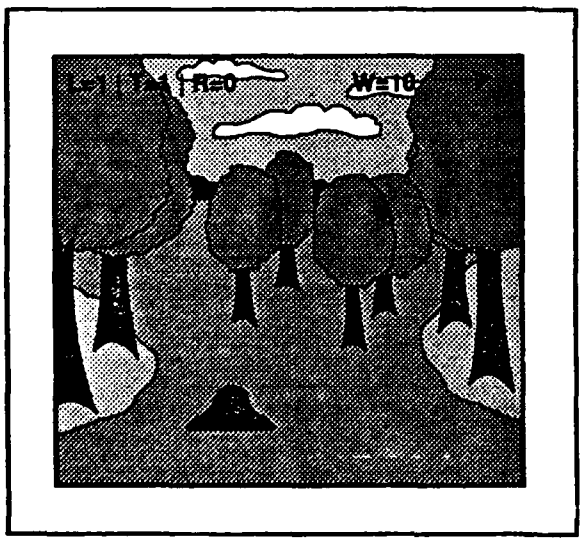
- Now return to skill level.
- Enter **G** to return to skill level.
- Title screen for selected level will appear next.



WIND

- The correct offset is illustrated for targets at three distances.
- The offset changes with each wind effect.

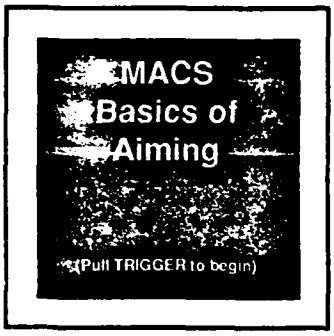
NOTE: Wind speed and direction will remain in effect unless program is restarted, or new wind speed and direction are entered using the menu.

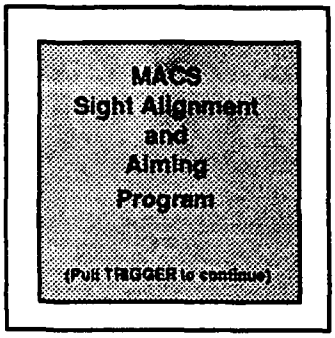


TARGET SCREEN

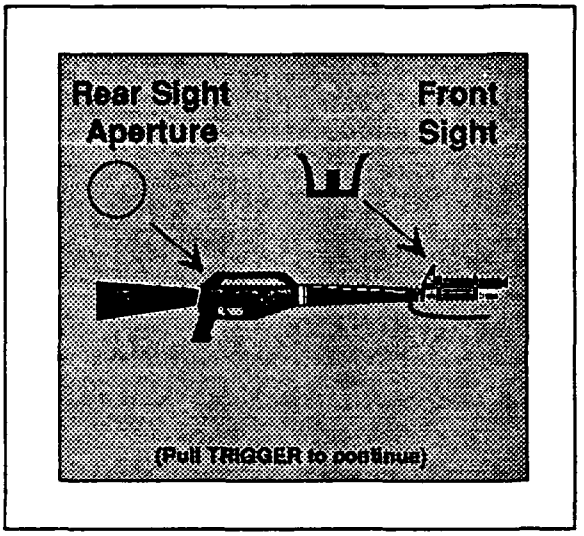
- Wind speed and direction are shown in upper right-hand corner of screen.

SIGHT AND GROUPING PROGRAM



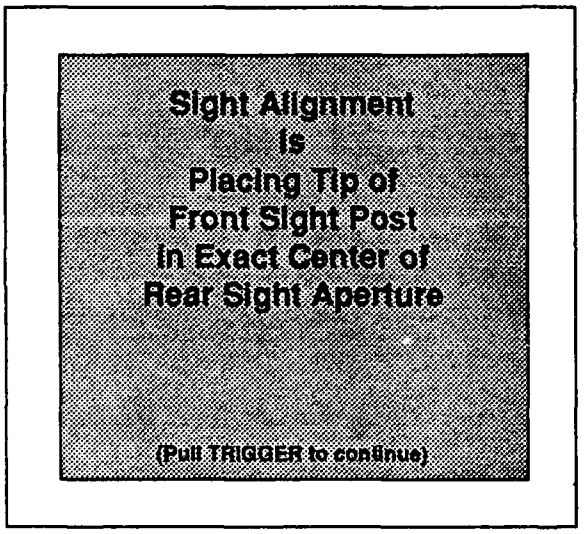


- The sight and grouping program is designed to teach and test the basic skills of sight alignment, aiming, and shot grouping to the novice marksman.
- The sight and grouping program has three parts:
    1. Sight alignment program.
    2. Aiming program.
    3. Grouping program.



LOCATION OF SIGHTS

- Front sight.
- Rear sight aperture.



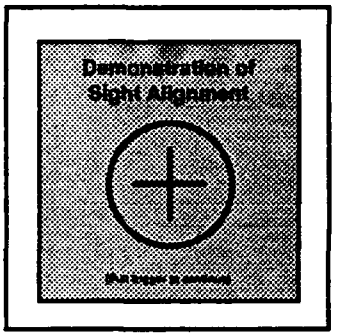
DEFINITION OF SIGHT ALIGNMENT

DEMONSTRATION OF SIGHT ALIGNMENT

SIGHT ALIGNMENT

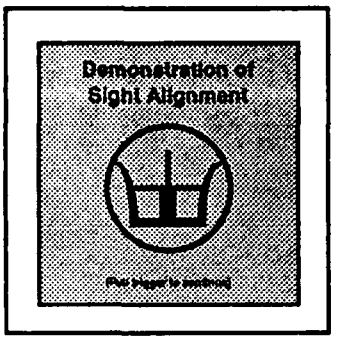
Part 1:

- Tip of front sight post is placed in center of rear of rear sight aperture.



Part 2:

- Center of rear sight aperture is designated by red cross.



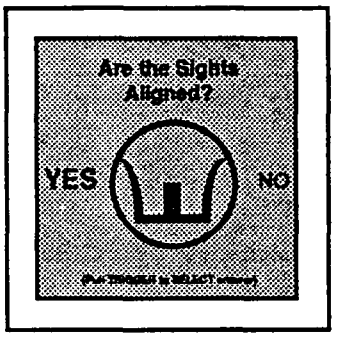
Part 3:

- Complete demonstration screen.
- Sequence returns to Part 1 unless trigger is pulled.

SIGHT ALIGNMENT TEST

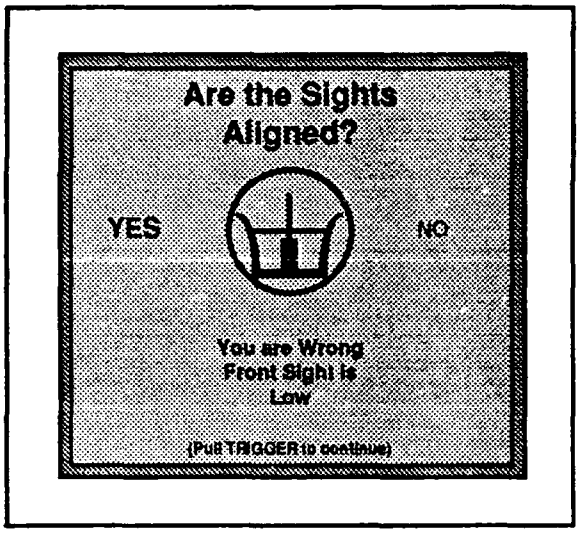
TEST INFORMATION SCREEN

- Tests ability to identify correct sight alignment.
- Must correctly identify three sight pictures in a row to pass test.



TEST SCREEN

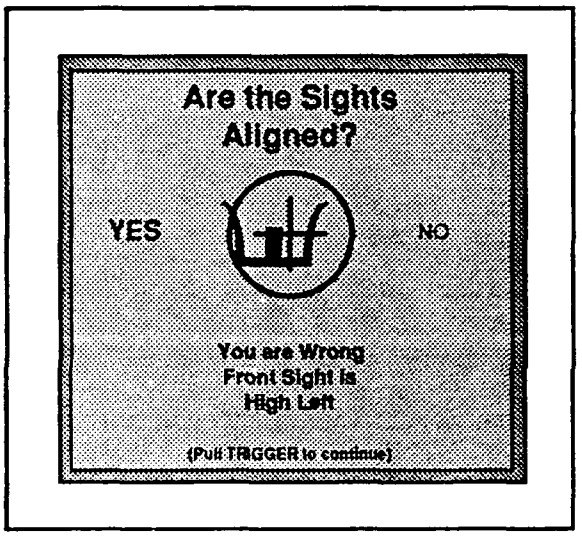
- Front and rear sights pictured.
- YES and NO alternately appear in large (boldface) type.
- Select answer by pulling trigger when choice appears in large (boldface) type.



SIGHT ALIGNMENT TEST FEEDBACK SCREENS

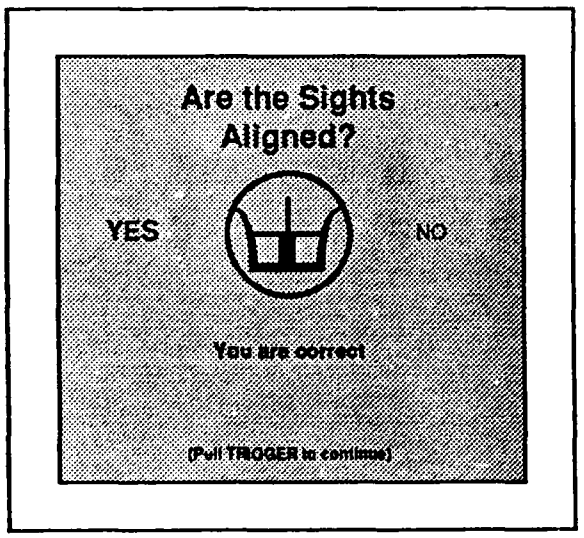
INCORRECT RESPONSE FEEDBACK

- Red border appears.
- Red cross designates correct placement of front sight in rear aperture.
- Error is described.



EXAMPLE

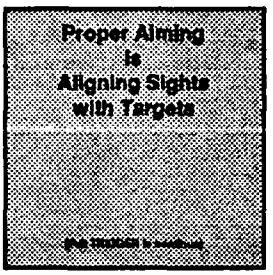
- Red border appears.
- Red cross designates correct placement of front sight in rear aperture.
- Error is described.



CORRECT RESPONSE FEEDBACK

- You are correct.

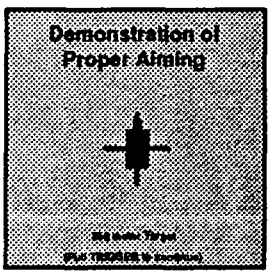
AIMING PROGRAM



Definition

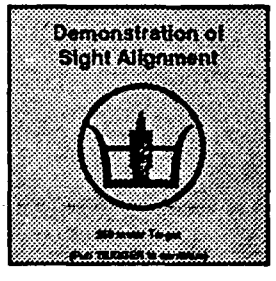
- Proper aiming is aligning sights with target.

DEMONSTRATION OF AIMING

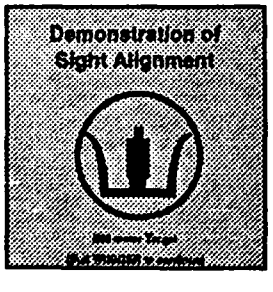


EXPLANATION

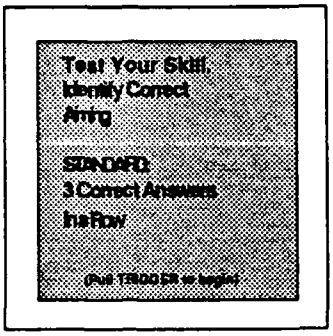
Part 1:
- Cross hairs designate center of mass of target.



Part 2:
- Correct sight alignment is placed at center of mass.

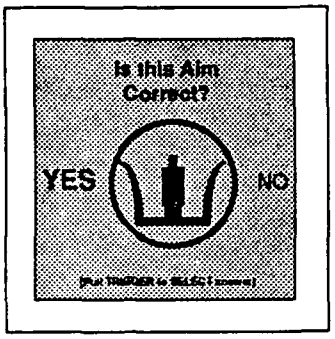


Part 3:
- Cross hairs are removed.
- Correct sight alignment shown at center of mass.
- Sequence returns to Part 1 unless trigger is pulled.



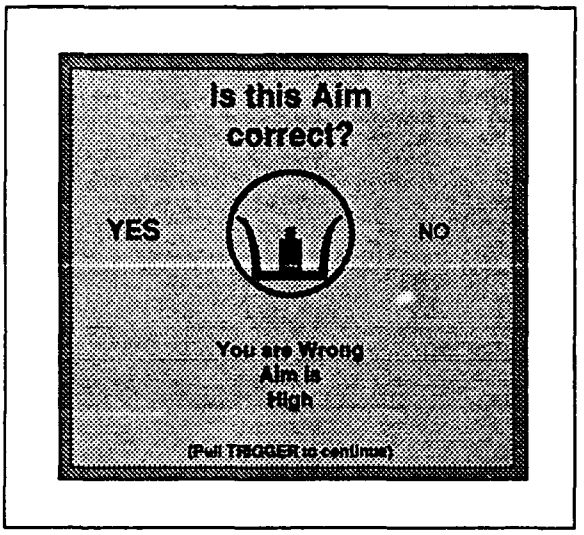
AIMING SKILL TEST

- Tests ability to identify correct sight picture.
- Must correctly identify three sight pictures in a row to pass test.



TEST SCREEN

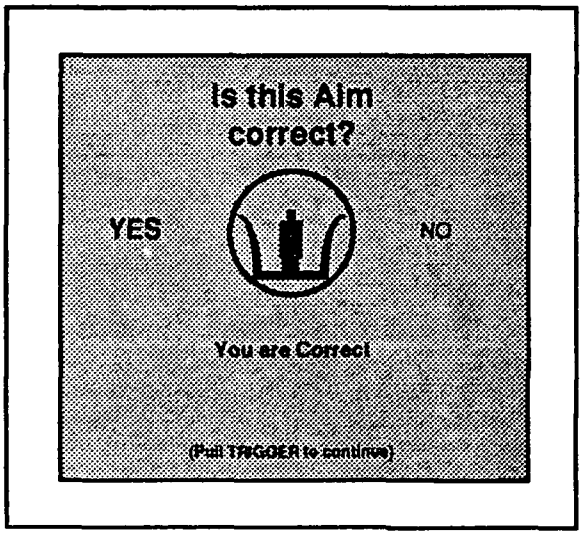
- YES and NO alternately appear in large (boldface) type.
- Select answer by pulling trigger when choice appears in large (boldface) type.



AIMING TEST FEEDBACK SCREENS

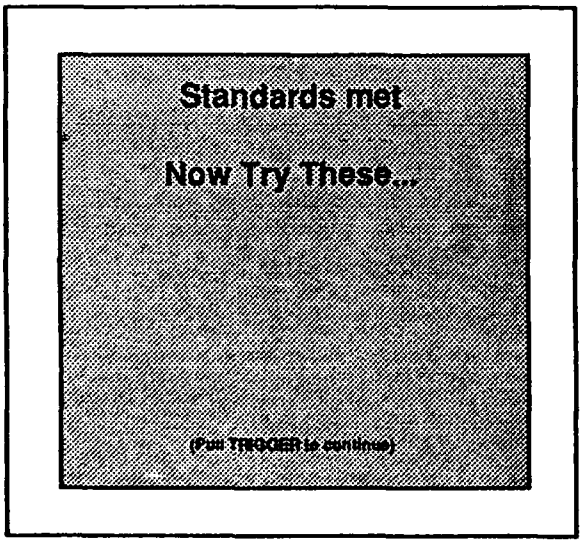
INCORRECT RESPONSE FEEDBACK

- Red border appears.
- Red cross designates center of mass of the target.
- Error is described.



CORRECT RESPONSE FEEDBACK

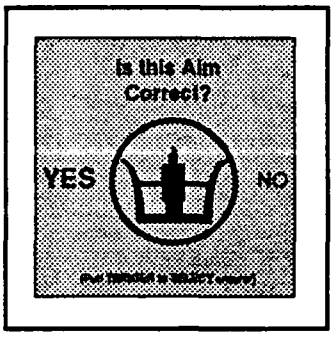
- You are correct.



AFTER THREE CORRECT RESPONSES IN A ROW:

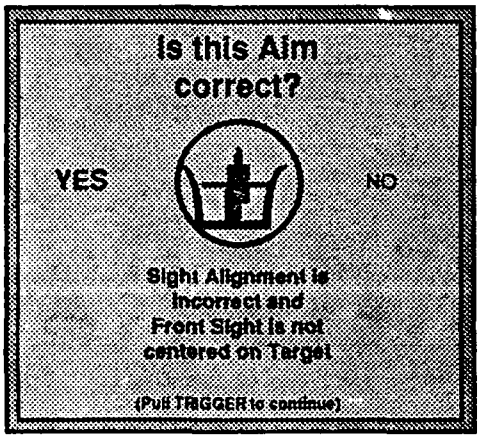
- Next set of screens test ability to identify correct sight alignment and sight picture.

ADVANCED AIMING TEST



ADVANCED AIMING SKILL TEST

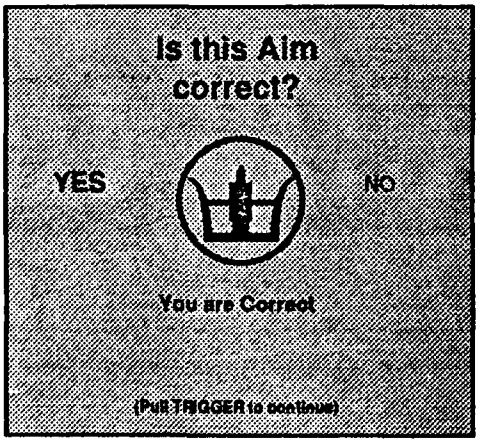
- Tests ability to identify correct sight alignment and sight picture.
- YES and NO alternately appear in large (boldface) type.
- Select answer by pulling trigger when choice appears in large (boldface) type.
- Must correctly identify three in a row to exit test.



ADVANCED AIMING TEST FEEDBACK SCREENS

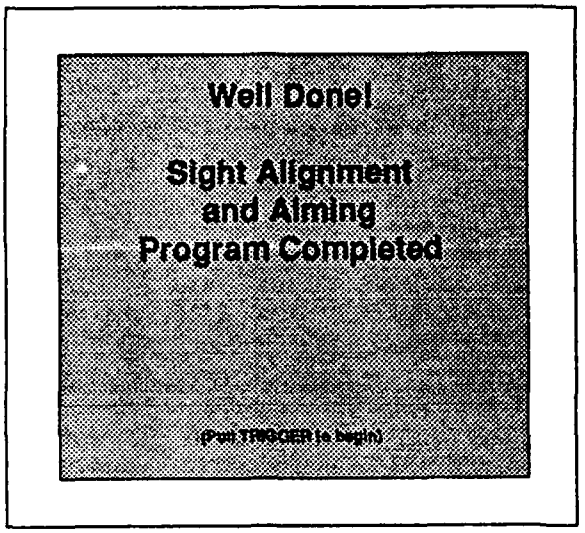
INCORRECT RESPONSE FEEDBACK

- Red border appears.
- Red cross designates center of mass of the target.
- Error is described.



CORRECT RESPONSE FEEDBACK

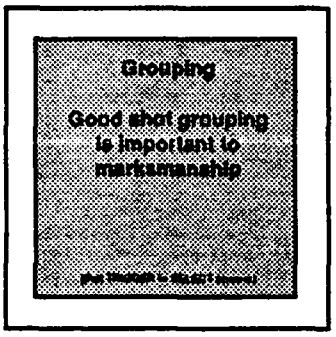
- You are correct.
- Front and rear sights are aligned correctly.
- Front sight is placed on center of mass of target.



AFTER THREE CORRECT RESPONSES IN A ROW:

- End of Aiming Program.

GROUPING PROGRAM



STATEMENT OF IMPORTANCE

- Tight shot groups indicate correct application of the four fundamentals of marksmanship.
  - Steady position
  - Aiming
  - Breath control
  - Trigger squeeze

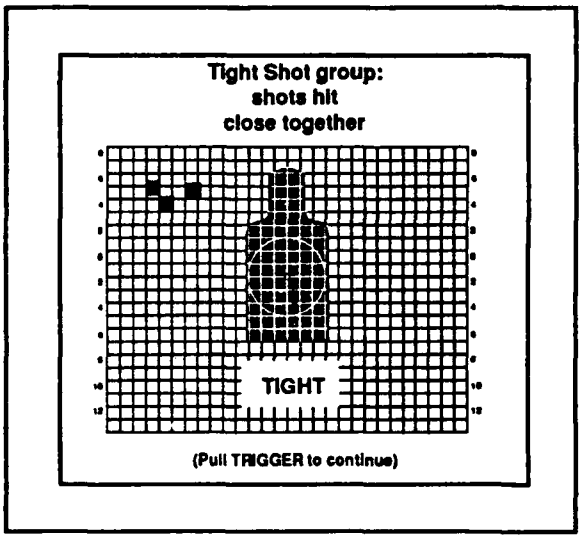
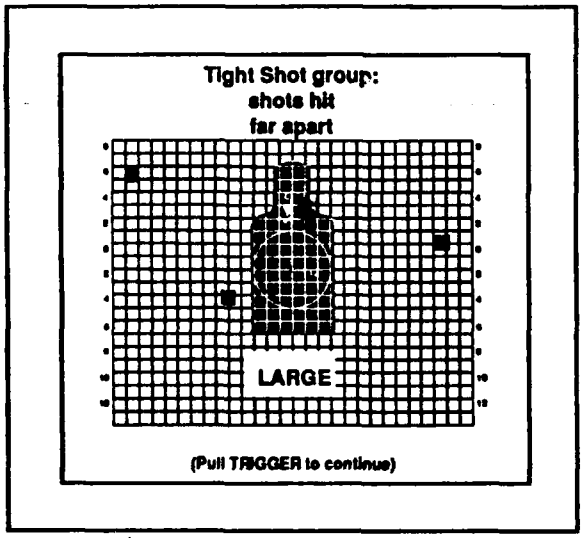


ILLUSTRATION OF SHOT GROUPS

TIGHT SHOT GROUP

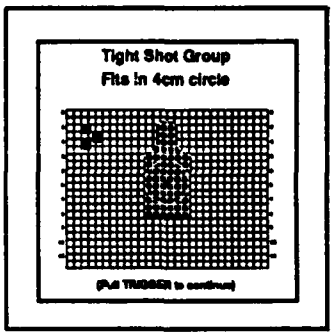
- Shots fit in 4 cm circle.



LARGE SHOT GROUP

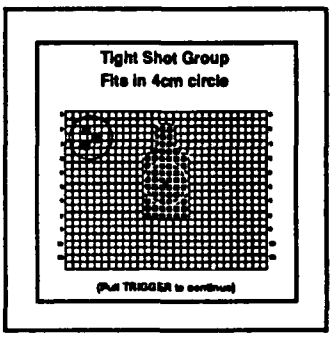
- Shots do not fit in 4 cm circle.

TIGHT SHOT GROUP



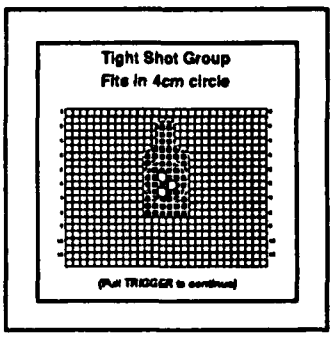
Part 1:

- 3 shots hit close together.



Part 2:

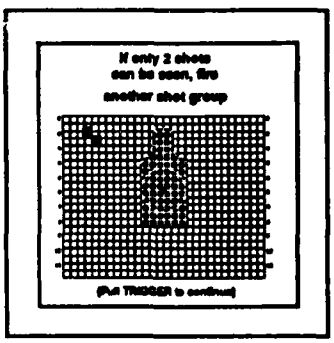
- Circle appears around shot group.



Part3:

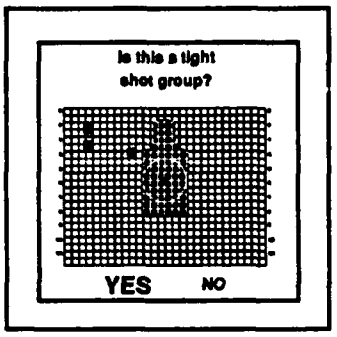
- Shot group moves to center of target.

TWO SHOT GROUP



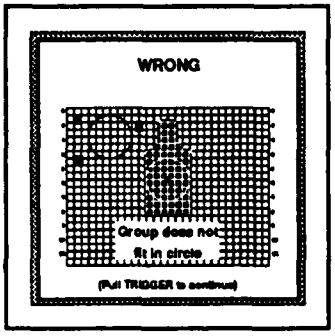
- One shot missed target.
- Fire another shot group.

GROUPING PROGRAM TEST



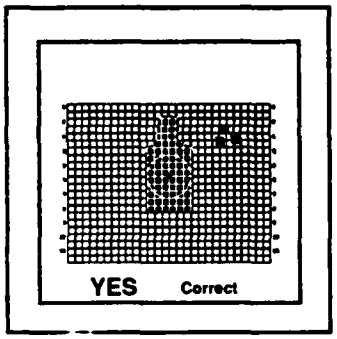
SHOT GROUP SKILL TEST

- Tests recognition of tight shot group.
- YES and NO alternately appear in large (boldface) type.
- Select answer by pulling trigger when choice appears in large (boldface) type.
- Must correctly identify three in a row to pass test.



INCORRECT RESPONSE

- Red border appears.
- Scaled, 4 cm circle moves to middle of shot group.
- Error is described.

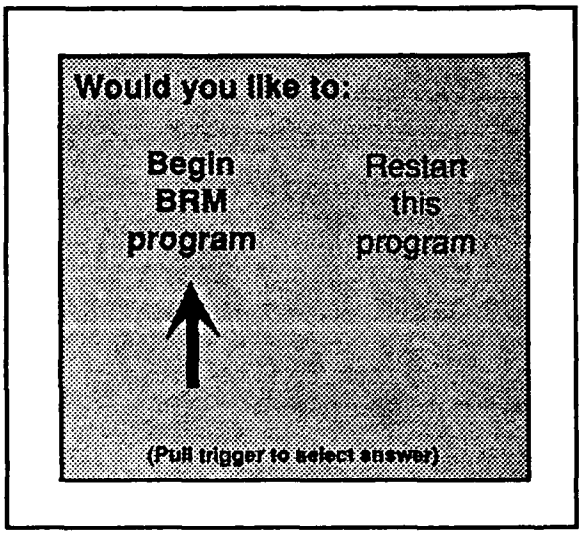


CORRECT RESPONSE

- You are correct.

AFTER THREE CORRECT RESPONSES IN A ROW

- Standards met.



END OF PROGRAM

- Select choice by pulling trigger when arrow points to desired response.

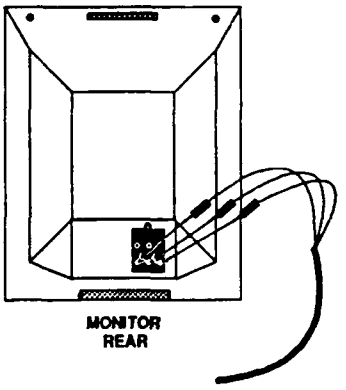
TROUBLESHOOTING TIPS

TROUBLESHOOTING TIPS

PROBLEM	SOLUTION
Computer will not come on.	Ensure power cords are plugged in.
	Ensure all power switches are turned on.
	Use a different outlet.
Program does not start.	**Turn off all power switches.** Take out and reinsert BRM cartridge.
	Turn on all power switches.
	Ensure shift lock key on keyboard is in UP position.
No sound.	Adjust volume control on monitor.
	Recheck cable connections.
Light pen does not work (purple border appears or light pen fails tracking test as described on page 2-7).	Check 5/8" gap on focal ring, if applicable.
	Recheck cable connections.
	Check distance to monitor screen. (Should be 7'6").
	Increase monitor brightness and/or contrast.
	Turn off computer. Restart system.
	Let monitor warm up.

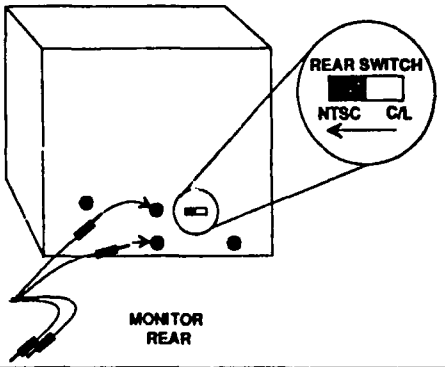
COMMODORE (Model 1802)

No picture.	Adjust BRIGHT to maximum (clockwise). (BRIGHT knob is located behind the panel at the front of the monitor).
	Turn off all power switches. Recheck cable connections.



HITACHI

No picture.	Adjust BRIGHT to maximum (clockwise). (BRT knob is located along the lower edge of the monitor at the front.)
	Turn off all power switches. Recheck cable connections.
	Ensure rear switch on back of monitor is set to NTSC.



FOR FURTHER INFORMATION

Broom, J. M., Champion, D. F., Greene, W. H., Martere, R. F., Purvis, J. W. ,& Sills, E. G. (1989). Multipurpose arcade combat simulator (MACS) basic rifle marksmanship (BRM) program. (ARI Research Report 90-01). Alexandria, VA: U. S. Army Research Institute for the Behavioral and Social Sciences.

This research report provides a more detailed discussion of the rationale behind the instructional design, standards, and feedback contained in the MACS BRM program.

Evans, K. L. (1988). Development and evaluation of the multipurpose arcade combat simulator: A research summary (ARI Research Report 1488). Alexandria, VA: U. S. Army Research Institute for the Behavioral and Social Sciences.

Available from the Defense Technical Information Center order no. AD-B 130 099.

This research report summarizes the results of over 20 developmental hardware tests, training and cost effectiveness evaluations, and informal field investigations conducted since 1982. Benefits associated with MACS training used in conjunction with standard training appear to be increased performance, fewer failures to meet performance standards, significantly lower expenditures of ammunition, improved performance feedback, and greater soldier interest.

Heller, F. H. & Evans, K. L. (1989). Joint service multipurpose arcade combat simulator (JMACS) user guide (ARI Research Product 89-23). Alexandria, VA: U. S. Army Research Institute for the Behavioral and Social Sciences.

This research product presents information on system assembly, operation, and troubleshooting of the JMACS hardware. Features of the JMACS training software and associated performance standards are also described. The MACS BRM software described in the Trainer's Guide and the report by Broom and associates (1989) has replaced the JMACS training software throughout the services. The updated software is available from the Training Support Center, Fort Benning, Georgia.